ERRATUM

Pringle, J.D., D.G. Robinson, G.P. Ennis, and P. Dubé. 1983. An overview of the management of the lobster fishery in Atlantic Canada. Can. MS Rep. Fish. Aquat. Sci. 1701: vii + 103 p.

Page v, line 7: "Secondary peaks in landings, at about 48.5 million lb (22000 t), occurred in 1924 and the 1950's."

Should read: "Secondary peaks in landings, at about 48.5 million lb (22000 t), occurred in 1932 and the 1950's."

Page vi, line 11: "En 1924 et au cours des années 1950, les débarquements ont été le plus faibles. En 1924 et au cours des années 1950, les débarquements on été relativement élevés, atteignant environ 48.5 millions de livres (22000 t).

Should read: "En 1932 et au cours des années 1950, les débarquements ont été relativement élevés, atteignant environ 48.5 millions de livres (22000 t)."

Page 1, last line: "...Robinson et al., in press)..."

Should read: "...Robinson et al., 1982)..."

Page 17, line 13: "...(Robinson and Pringle, in press)."

Should read: "...(Robinson and Pringle, 1982)."

Page 33, Figure caption: "Figure 9. Annual landins and..."

Should read: "Figure 9. Annual landings and..."

Page 35, line 38: "...cited by Dupont et al., 1976)],..."

Should read: "...cited by Dupont and Boudreault, 1976)],..."

Page 73, line 40: "...(Fig. 9)."

Should read: "...(Fig. 2)."

Page 73, line 41: "...Fig. 12)."

Should read: "...Fig. 10)."

Page 86, line 14: "Lavoie, N. 1977."

Should read: "Lavoie, N. 1877."

Page 87, line 15: "Robinson, D.G., J.D. Pringle, A. Campbell, and R.W. Elner. In press. Discussion paper on lobster management. Can. MS Rep. Fish. Aquat. Sci."

Should read: "Robinson, D.G., J.D. Pringle, A. Campbell, and R.W. Elner. 1982. Discussion paper on lobster management. Unpubl. MS, I&MP Div., Hfx. Fish. Res. Lab.

Page 87, line 18: "Robinson, D.G. and J.D. Pringle. In press. Application of a simplified stock recruitment mode to some Maritime lobster populations. CAFSAC Res. Doc."

Should read: "Robinson, D.G. and J.D. Pringle. 1982. Application of a simplified stock recruitment model to some Maritime lobster populations. Unpubl. MS, I&MP Div., Hfx. Fish. Res. Lab.

An Overview of the Management of the Lobster Fishery in Atlantic Canada

J.D. Pringle, D.G. Robinson, [1]
G.P. Ennis, [2] and P. Dubé [3]

Fisheries Research Branch
Department of Fisheries and Oceans
Halifax Fisheries Research Laboratory
Halifax, N.S. B3J 2S7

[1] Fisheries Operations Branch
Department of Fisheries and Oceans
Halifax, N.S. B3J 2S7

[2] Fisheries Research Branch
Department of Fisheries and Oceans
St. John's, Nfld. AIC 5X1

[3] Department of Agriculture and Fisheries
Province of Québec
Magdalen Islands, P.Q.

May, 1983

Canadian Manuscript Report of Fisheries and Aquatic Sciences 1701

Canadian Manuscript Report of Fisheries and Aquatic Sciences

These reports contain scientific and technical information that represents an important contribution to existing knowledge but which for some reason may not be appropriate for primary scientific (i.e. *Journal*) publication. They differ from Technical Reports in terms of subject scope and potential audience: Manuscript Reports deal primarily with national or regional problems and distribution is generally restricted to institutions or individuals located in particular regions of Canada. No restriction is placed on subject matter and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries management, technology and development, ocean sciences, and aquatic environments relevant to Canada.

Manuscript Reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report will be abstracted by *Aquatic Sciences and Fisheries Abstracts* and will be indexed annually in the Department's index to scientific and technical publications.

Numbers 1-900 in this series were issued as Manuscript Reports (Biological Series) of the Biological Board of Canada, and subsequent to 1937 when the name of the Board was changed by Act of Parliament, as Manuscript Reports (Biological Series) of the Fisheries Research Board of Canada. Numbers 901-1425 were issued as Manuscript Reports of the Fisheries Research Board of Canada. Numbers 1426-1550 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Manuscript Reports. The current series name was changed with report number 1551.

Details on the availability of Manuscript Reports in hard copy may be obtained from the issuing establishment indicated on the front cover.

Rapport manuscrit canadien des sciences halieutiques et aquatiques

Ces rapports contiennent des renseignements scientifiques et techniques qui constituent une contribution importante aux connaissances actuelles mais qui, pour une raison ou pour une autre, ne semblent pas appropriés pour la publication dans un journal scientifique. Ils se distinguent des Rapports techniques par la portée du sujet et le lecteur visé; en effet, ils s'attachent principalement à des problèmes d'ordre national ou régional et la distribution en est généralement limitée aux organismes et aux personnes de régions particulières du Canada. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du Ministère des Pêches et des Océans, notamment gestion des pêches; techniques et développement, sciences océaniques et environnements aquatiques, au Canada.

Les Manuscrits peuvent être considérés comme des publications complètes. Le titre exact paraît au haut du résumé de chaque rapport, qui sera publié dans la revue *Aquatic Sciences and Fisheries Abstracts* et qui figuera dans l'index annuel des publications scientifiques et techniques du Ministère.

Les numéros de 1 à 900 de cette série ont été publiés à titre de manuscrits (Série biologique) de l'Office de biologie du Canada, et après le changement de la désignation de cet organisme par décret du Parlement, en 1937, ont été classés en tant que manuscrits (Série biologique) de l'Office des recherches sur les pêcheries du Canada. Les numéros allant de 901 à 1425 ont été publiés à titre de manuscrits de l'Office des recherches sur les pêcheries du Canada. Les numéros 1426 à 1550 ont été publiés à titre de Rapport manuscrits du Service des pêches et de la mer, Ministère des Pêches et de l'Environnement. Le nom de la série a été changé à partir du rapport numéro 1551.

La page couverture porte le nom de l'établissement auteur où l'on peut se procurer les rapports sous couverture cartonnée.

Canadian Manuscript Report of
Fisheries and Aquatic Sciences 1701

May 1983

AN OVERVIEW OF THE MANAGEMENT OF THE LOBSTER FISHERY IN ATLANTIC CANADA

by

J.D. Pringle, D.G. Robinson,[1] G.P. Ennis,[2] and P. Dubé[3]

Fisheries Research Branch
Department of Fisheries and Oceans
Halifax Fisheries Research Laboratory
Halifax, N.S. B3J 2S7

[1]Fisheries Operations Branch
Department of Fisheries and Oceans
Halifax, N.S. B3J 2S7

[2]Fisheries Research Branch
Department of Fisheries and Oceans
St. John's, Nfld. A1C 5X1

[3]Department of Agriculture and Fisheries
Province of Québec
Magdalen Islands, P.Q.

(c) Minister of Supply and Services Canada 1983

Cat. No. Fs 97-4/1701 ISSN 0706-6473

Correct citation for this publication:

Pringle, J.D., D.G. Robinson, G.P. Ennis, and P. Dubé. 1983. An overview of the management of the lobster fishery in Atlantic Canada. Can. MS Rep. Fish. Aquat. Sci. 1701: vii + 103 p.

CONTENTS

Abstract v

Résumé vi

Introduction 1

Maritime lobster fishery 2

Brief history 2

Status of lobster stocks 15

Southern Gulf of St. Lawrence (Districts 7b, 7c, and 8) 15

Southeast coast of Nova Scotia (Districts 4 East, 5, 6a, Southern 6b, 7a) 17

Southwest Nova Scotia/Bay of Fundy (Districts 1, 2, 3, 4 West) 17

Environmental quality 18

Newfoundland lobster fishery 19

Brief history 19

Status of the stocks 29

Economic aspects 30

Québec lobster fishery 32

Brief history and stock status 32

Gaspésie and Bonaventure 32

Magdalen Islands 35

Improving economic returns 43

Increasing yields 43

Lobster marketing 43

Market trends 47

Seasonal supply 51

Lobster size and demand 61

Lobster quality 65

General discussion 73

Management advice 73

Management alternatives 78

Conclusions 79

Summary and recommendations 81

Acknowledgements 84

References 84

Appendix A: List of workshop attendees 89

B: Letter of invitation to workshop - mandate . . 93

C: Agenda of workshop 97

D: Seasons and carapace lengths for lobster fishing districts in Atlantic Canada 101

ABSTRACT

Pringle, J.D., D.G. Robinson, G.P. Ennis, and P. Dubé. 1983. An overview of the management of the lobster fishery in Atlantic Canada. Can. MS Rep. Fish. Aquat. Sci. 1701: vii + 103 p.

Lobsters are the most important inshore fishery, harvested throughout coastal Maritime waters (plus a small offshore fishery), from around the island of Newfoundland, and from Québec's Gulf of St. Lawrence. Lobsters usually rank first or second in landed value in the Maritimes. Canadian landings peaked at 105 million lb (47600 t) in 1886 and troughed at 26.9 million lb (12200 t) in 1924. Secondary peaks in landings, at about 48.5 million lb (22000 t), occurred in 1924 and the 1950's.

Most stocks are judged to be recruitment overfished with exploitation rates between 70% and 90% and minimum legal carapace length at or below size at reproductive maturity; some stocks have collapsed (catches at 5% of maximum level). Recommended rehabilitation measures include raising minimum legal carapace lengths to 3.0" (7.6 cm) in warm-water stocks and either 3.5" (8.9 cm) or 4.0" (10.2 cm) in cold-water stocks.

Canada is the only major net exporter of clawed lobsters; markets are strong and expanding. Often, neither lobster sizes nor seasons match demand. A marketing study is recommended to assess future market requirements. Further research is required in both the economics of the fishery and population biology of the lobster.

Key words: Lobsters, lobster fishery, lobster stocks, resource management, marketing, regulations, population biology, carapace length, landings, Maritimes, Newfoundland, Québec, southwestern Nova Scotia, Gulf of Maine.

RÉSUMÉ

Pringle, J.D., D.G. Robinson, G.P. Ennis, and P. Dubé. 1983. An overview of the management of the lobster fishery in Atlantic Canada. Can. MS Rep. Fish. Aquat. Sci. 1701: vii + 103 p.

La pêche du homard est la plus importante pêche côtière des Maritimes; elle se pratique dans toutes les eaux côtières des Maritimes (où il y a également une pêche hauturière de moindre importance), autour de l'île de Terre-Neuve et dans la partie du golfe du Saint-Laurent qui touche au Québec. Dans les Maritimes, la pêche du homard est habituellement l'une des deux pêches les plus importantes pour ce qui est de la valeur au débarquement. C'est en 1886, avec 105 millions de livres (47600 t), que les débarquements de homard ont été le plus élevés au Canada et c'est en 1924, avec 26.9 millions de livres (12200 t), qu'ils ont été le plus faibles. En 1924 et au cours des années 1950, les débarquements ont été le plus faibles. En 1924 et au cours des années 1950, les débarquements ont été relativement élevés, atteignant environ 48.5 millions de livres (22000 t).

On estime qu'à l'heure actuelle la plupart des stocks sont surexploités par rapport au recrutement; les taux d'exploitation se situent en effet entre 70 et 90% et la longueur minimale légale de la carapace est égale ou inférieure à la taille que

doit atteindre le homard pour pouvoir se reproduire. Certains stocks se sont effondrés (les prises sont égales à 5% du niveau maximal). Comme mesure de rétablissement des stocks, on recommande, entre autres, que la longueur minimale légale de la carapace soit portée à 3.0" (7.6 cm) pour les stocks vivant en eau chaude et à 3.5" (8.9 cm) ou à 4.0" (10.2 cm) pour les stocks vivant en eau froide.

Le Canada est le seul pays dont les exportations de homard sont élevées et dépassent nettement les importations; les marchés sont bien établis et en pleine croissance. Il arrive souvent que la demande ne puisse être satisfaite en raison de la taille des homards ou des saisons de pêche. On recommande qu'une étude de commercialisation visant à évaluer les exigences futures du marché soit menée. Il faut également que d'autres recherches soient effectuées tant en ce qui a trait à l'aspect économique de la pêche qu'en ce qui concerne la biologie des stocks du homard.

INTRODUCTION

The lobster fishery is ubiquitous along coastal Newfoundland, Quebéc, and the Maritime provinces. Some 15,000 licenced fishermen set their traps annually with the assistance of an equal number of helpers. Thousands of shore workers are associated with processing and shipping. Consequently, it is important to optimize the value of this industry by providing a strong harvest and increased profitability.

The market, in the absence of current marketing data, seems to be strong. Lobsters are readily accepted throughout the world as luxury food. The most prized genus is the clawed lobster, Homarus spp., of which Canada is the only net exporting country. The industry in 1980 was valued at $120 million in Atlantic Canada; 80% of this was earned on the international market. The overseas percentage has recently increased markedly due to aggressive marketing of live and whole frozen animals. The industry has problems, however, as buyers often cannot get the type of animals they require and many of our stocks [a unit of the population on which the fishery acts (Larkin, 1978)] are either collapsed or on the verge of collapse (Anthony and Caddy, 1980; Robinson, 1980).

Biological studies in the mid to late 1970's suggested many local stocks were recruitment overharvested (Anthony and Caddy, 1980; Robinson, 1979); more lobsters were being removed from the system than were required to maintain catch rates at acceptable levels. Furthermore, it was noted that the legal minimum sizes in all stocks were set to yield well below maximum yield per recruit (Anthony and Caddy, op. cit.). Recommendations by federal fisheries personnel, which might have improved sustained yields, have not been implemented; and this is in spite of both total federal jurisdiction over the common property resource and an expressed desire by the Department of Fisheries and Oceans to: 1) promote a viable, self-sustained fishery; 2) optimize the economic returns to all sectors of the industry; and 3) achieve maximum employment opportunities (Anonymous, 1980).

All sectors of the industry have their hypotheses as to what is wrong. Questions which remain unanswered are: why do some producers have little resource and strong demand while others have a strong resource and little demand; why do buyers have either a glut of the wrong-sized animals or too few of the correct-sized animals; and why do certain lobster stocks maintain high sustained landings while others have collapsed?

Following perusal of a Fisheries Research Branch draft report on Maritime lobsters ("Discussion Paper on Lobster Management;" Robinson et al., in press), senior management

requested that a "...summary document..." with "...firm conclusions..." be prepared for the Canadian Atlantic lobster fishing area. Dr. J.D. Pringle, Fisheries Research Branch, Scotia-Fundy Region, accepted the leadership role. Representatives (Appendix A) from each Atlantic region were invited (Appendix B) to a workshop June 22 and 23, 1982, in Halifax to develop "An Overview of the Management of the Lobster Fishery in the Atlantic Zone." Topics covered were:

a) Brief history of the fisheries;
b) Review of stock status;
c) Current management regimes;
d) Markets and developing trends; and
e) Management alternatives.

Documents on the first three topics were prepared by certain delegates prior to the workshop; the contents were approved by workshop attendees. Portions of these documents have been employed in the present report. L. Sonkodi, Marketing Directorate, Ottawa, presented what little data are available on the international marketing of lobsters. Some of it has been used in this report.

MARITIME LOBSTER FISHERY

BRIEF HISTORY

The origins of the Canadian lobster fishery can be traced to 1851, when five small canneries were operating in western Nova Scotia (White, F.M. in Wakeham, 1909, p. 440); major developments commenced in 1869. The first large cannery was constructed in the same area by American entrepreneurs seeking new sources of supply due to declining American catches. In that year 61,00 1-lb cans were preserved in Canada (Prince, 1899). Subsequent growth of the industry was rapid; by 1873, 67 canneries (Table 1) recorded 4,865,000 1-lb cans preserved. Of the Nova Scotia canneries, 40 (93%) were located along the southeast coast (Fig. 1) from Shelburne County through to Cape Breton County. The first live shipment of 1.2 million lb (543 t) was recorded in 1881; as well, 17,491,000 1-lb cans were preserved. The development of the live trade was controlled by the proximity of the fishery to the Boston market.

By 1890, there were more than 331 canneries in the Maritimes; in Nova Scotia 24 were west of Halifax County and 74 were on mainland Nova Scotia from Halifax County east (Anonymous, 1890). In that year, about one-third of the western Nova Scotia catch was sold live in the United States (Inspector Kinney, op. cit.), whereas in eastern Nova Scotia "...a very small trade (in live exports)...from west division of Halifax County; none from other divisions..." (Inspector Hockin, op. cit.).

Table 1. Number of lobster canneries per Maritime province for selected years between 1873 and 1978.

Year	Nova Scotia	New Brunswick	Prince Edward Island	Total
1873	43	24	-	67
1890	133	100+	98	331+
1892	182	185	212	579
1900	277	237	246	760
1910	214	185	187	586
1925	139	144	148	431
1939	-	-	-	191
1944	39	49	49	137
1978	2	11	10	23

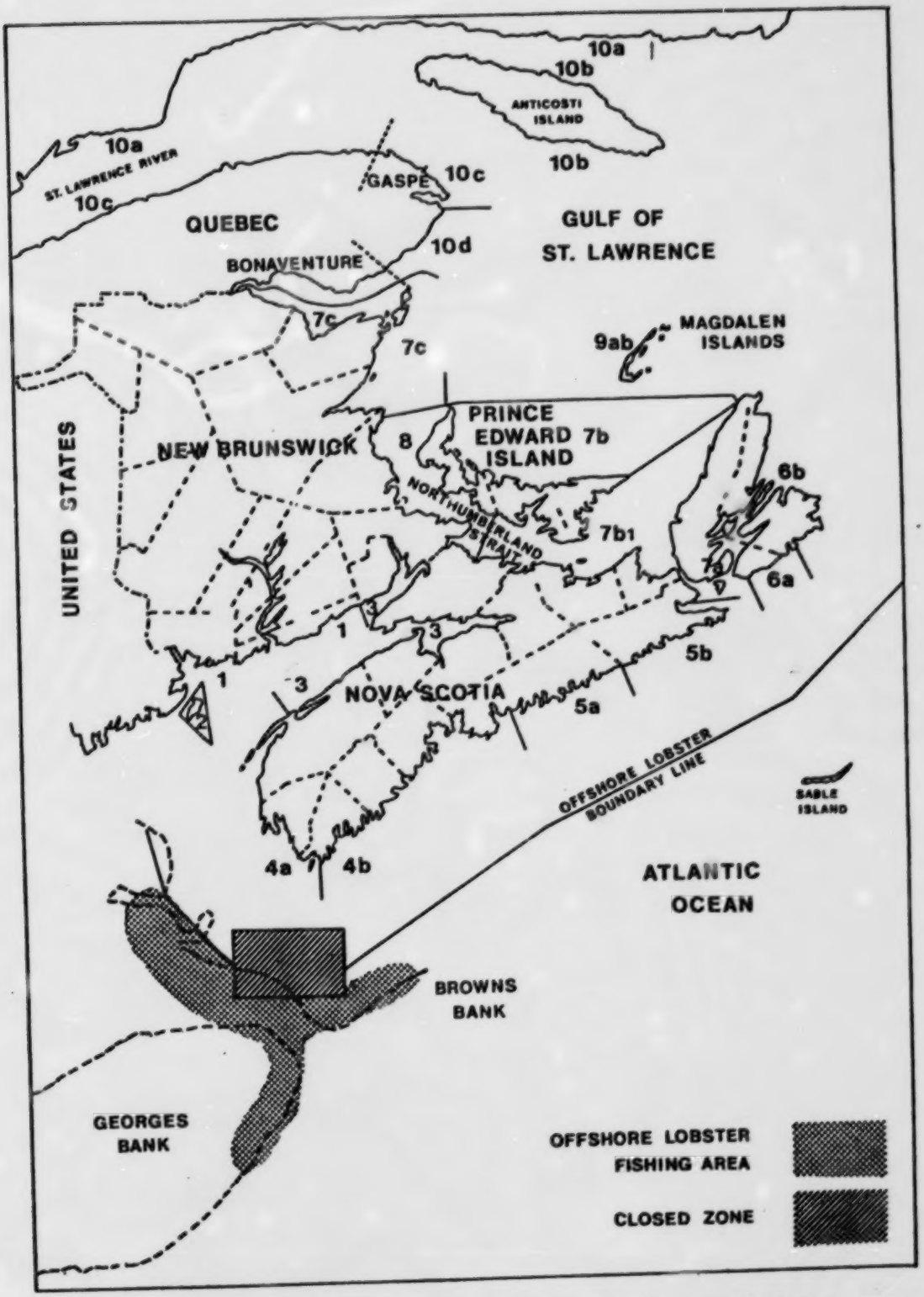

Figure 1. Lobster fishing districts for the Maritimes and Québec.

Canadian lobster landings peaked in the mid 1880's (Fig. 2) as demand increased with the decline of the American fishery. The Canadian landed price increased from 1¢ or 2¢ per lobster to 10¢ or 20¢ (Prince, 1899). The demand for canned Canadian lobster was further spurred by the closing of canneries in Maine in 1897, because of a decision to restrict the fishery in that state to lobsters large enough for the live market trade. The number of canneries in Canada more than doubled to 760 in 1900, the peak year for Canadian lobster canneries (Table 1). Improved rail facilities rendered live shipments from Nova Scotia's eastern shore more feasible. Thus, by 1900 about 20% of the catch was exported live; by 1925 this had increased to 30%.

The industry remained unchanged for the next three decades. As late as 1925 about 44% of the catch from southwestern Nova Scotia was canned (Found, 1927). This probably did not change until the application of market size limits throughout western Nova Scotia in 1933 (Sutherland, 1937).

A shift occurred in the late 1920's, caused by declining prices for canned lobster meat (chiefly a function of competition on the European market from canned Japanese crab meat - 80% of pre-World War II lobster cannery production was sold overseas) and increasing demand for live lobsters. A subsidized collection service by vessel was inaugurated in 1930 along the eastern shore (including Richmond County) to facilitate live shipments. About 1.5 million lb (680.4 t) of lobsters were handled in 1934.

In 1940, a small section of the Richmond County coast [Lobster District 6a (Fig. 1)] was identified as observing a "market" size limit. This district was expanded to its present boundaries in 1947. District 7a was also formed (as distinct from 7b) as a "market" fishery. In the latter 1950's fishermen in Districts 5 and 6b started to phase out the "cannery" portion of their fisheries. This process was completed in District 5 in 1961, with the attainment of a market size limit, but was halted part way in District 6b in 1957. Today in Nova Scotia only fishermen in Districts 6b and 7b are fishing at smaller than market size.

Whereas the character of the Nova Scotia lobster industry was established by the turn of the century, the fishery itself continued to develop. The use of gasoline engines, and decreasing inshore catches, led certain western Nova Scotia fishermen to "...relinquish the inshore and harbour fishing and carry on lobstering in deeper water...to 20 or 30 fathoms..." (Prince, 1899). One power-driven boat would tow a number of others out to the grounds and back again at the end of the day. In 1916 it was observed that "...around the shores of the counties of Shelburne and Yarmouth...they go out some 18 or 20 miles off the coast of the mainland. This has necessitated the best equipment of motor boats and fishing gear, and there was nothing to be seen elsewhere to match their mechanically

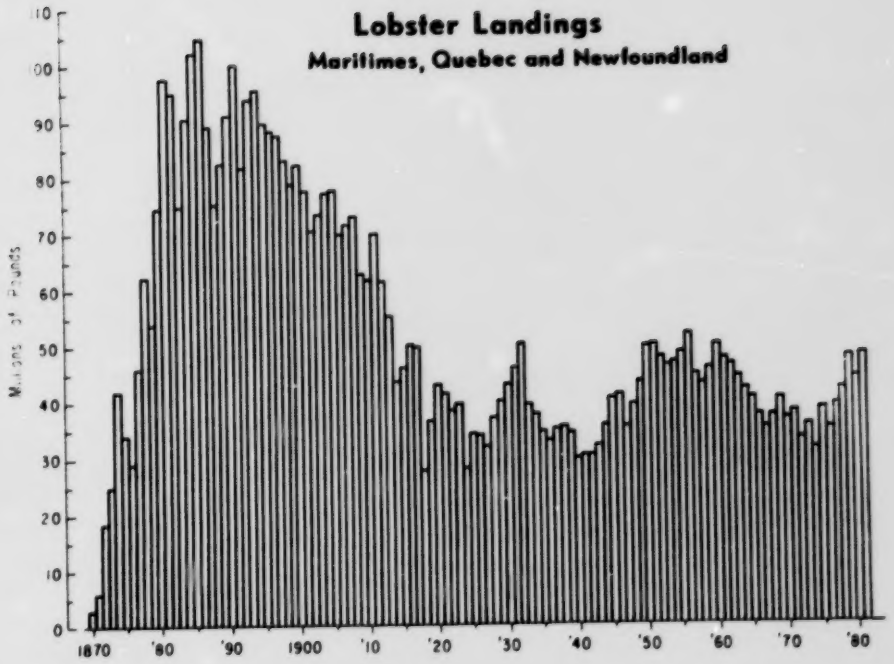

Figure 2. Annual Canadian lobster landings, 1870-1981.

worked trap hoists, the general efficiency of their boats, or their methods of fishing..." (Halkett, 1916). By contrast, fishermen interviewed in the 1970's (D.G. Robinson, unpub. data) stated that trap haulers were not generally introduced into Guysborough County until after World War II.

Other significant developments were the introduction of the parlour trap early in the century and the echo sounder in the post-war era. Many contemporary fishermen have other electronic gear such as radio, loran, and radar, as well as larger, faster, more reliable, and more comfortable boats. Thus, they are a far more efficient predator of lobsters than their predecessors. The drastic decline in landings, particularly in Districts 4 East and 5, may be due to recruitment overharvesting.

By the 1890's the fishery had been underway for about 40 years in some areas. This was evident in the mean size of the lobsters in the catch. The average weight of canners in the catch of the 1890's was about 1 lb (0.45 kg), whereas market lobsters were about 1.25 lb (0.68 kg) (Anonymous, 1890). This suggests that the fishery was no longer based on a standing stock of old lobsters. By 1898, even with a catch of about 82 million lb (37195 t), it was observed (Prince, 1899, p. 8) that "...the signs of exhaustion are unmistakable. Small immature lobsters, 5" to 8" or 9" (12.7 cm to 20.3 cm or 22.9 cm) long [0.2 lb (0.09 kg) to 1.0 lb (0.45 kg)], which a few years ago were rejected with contempt, are now eagerly taken and form in some districts the staple article upon which the lobster canners depend. Instead of two or three lobsters sufficing to fill a 1-lb can, not less than five, six, seven, and even ten lobsters are now required..."

The landings had begun to decline by 1898, but the worst was yet to come (Fig. 2). The fishery of the eastern coast of Nova Scotia was to decline from about 13 million lb (5897 t) annually to less than 4 million lb (1814 t) in the early 1920's (Fig. 3). The western Maritimes declined from about 20 million lb (9072 t) annually to about 5 million lb (2268 t) in the mid 1930's (Fig. 4).

The landings in western Nova Scotia, prior to 1933, exhibited a fairly steady decline from the turn of the century (Fig. 4). They rebounded in the early 1940's, about a generation length after the application of a market size limit. The landings held up rather well between the mid 1940's and the present. There is some concern, however (Campbell and Duggan, 1980), as the lobstermen are fishing farther from port with better gear and yet the landings are remaining stable or decreasing slightly. Here, there is a sizeable offshore lobster stock [beyond the 50-mile line (Fig. 1)] which is exploited by an offshore fleet. The inshore fleet has for some time been extending inshore grounds, but effort and effort distribution in the lobster fishery has not been documented. Thus, it is not known the extent to which current landings are supplemented by lobsters from previously unfished middle grounds.

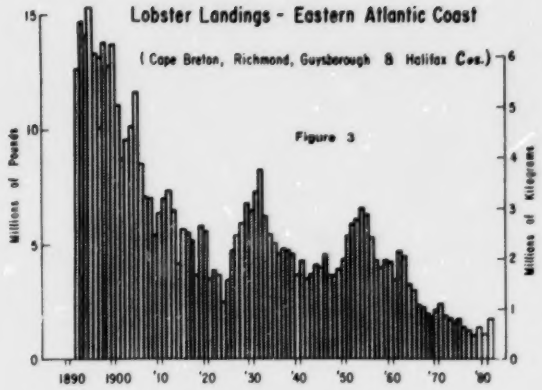

Figure 3. Annual lobster landings of the eastern Atlantic coast of Nova Scotia (Lobster Fishing Districts 5, 6a, 6b, and 7a) between 1892 and 1981.

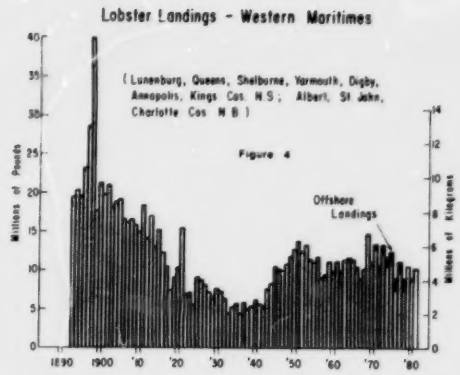

Figure 4. Annual lobster landings of southern and western Nova Scotia and southern New Brunswick (Districts 1-4) between 1892 and 1981 (the dark portion of the bars - 1972 to 1978 - represent offshore landings).

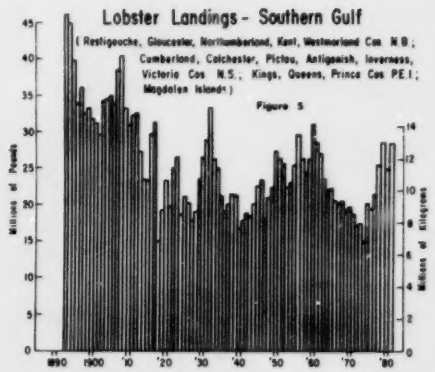

Figure 5. Annual lobster landings of the southern Gulf of St. Lawrence including the Magdalen Islands (Districts 7b, 7c, 8, 9a, and 9b) between 1892 and 1981.

STATUS OF LOBSTER STOCKS

The term "stock" is employed by fisheries biologists to denote "the part of a fish population which is under consideration from the point of view of actual or potential utilization" (Ricker, 1975): it has no biological meaning. The concept employed by biologists is "population." A population, according to Pielou (1976), is all the members of one species that inhabit an area sufficiently small to enable them to interbreed freely. This is an important concept to ecologists and fisheries scientists; it is generally felt that this should be the basic fisheries management unit. A dedicated study to discern a lobster population has not been carried out.

The calculated exploitation rate of all fished lobster stocks is high. If a stock is declining, recruitment overfishing is often hypothesized as the cause as the legal minimum size is substantially below that at which lobsters become sexually mature. As well, fecundity increases with the size of the lobster. Thus, if exploitation rates are indeed high most females will be captured prior to egg production. Those that produce eggs will, in most cases, be small and hence not be producing a maximum clutch size.

Harding et al. (1983) and Campbell and Mohn (in press) have recently attempted lobster population discrimination by analyzing 90 years of landings data. Based on their hypotheses we employ the concept of three populations: southern Gulf of St. Lawrence, southeast coast of Nova Scotia, and southwestern Nova Scotia and the Bay of Fundy. Presented below is a cursory review of each stock.

Southern Gulf of St. Lawrence (Districts 7b, 7c, and 8)

The landings for this area are given in Figure 5. Recruit annual mortality is around 80% to 90% (D.G. Robinson, unpub. data). Despite this, the harvest has been sustained for many stocks: the central portion of eastern New Brunswick (portions of Districts 7c and 8), the northern coast of Prince Edward Island, and the southeastern corner of the Gulf including the north shore of Cape Breton County. The stocks have collapsed in central Northumberland Strait, with landings at about 5% of historic maximum catches. The landings in northern New Brunswick and the Magdalen Islands have undergone long-term cyclical trends of varying magnitudes which appear to have recently peaked.

Although the evidence is not conclusive (Munroe and Therriault, 1981; Wilder, 1963), summer temperatures may be sufficiently high over much of the southern Gulf to permit two molts per year in newly recruited lobsters. Mature females usually extrude eggs rather than molt the second time. Legal minimum sizes are at the bottom range of the reproductively mature size. Thus, many females are functionally mature upon

first molt into legal size (molting occurs in July/August). Egg extrusion (egg incubation on the female takes about 11 months) occurs following molt; thus in a spring fishery "berried" females (those incubating eggs) are protected. This may, in part, be the reason for sustained recruitment in certain stocks.

In a fall fishery (August 10 to October 10 - District 8) many of the recruits have only recently molted; hence quality is poor [the poorest lobsters in Canada (A.P.M. Verhaart[1])]. Many of the females are captured prior to extrusion of eggs; thus recruitment overharvesting should be evident. The fishery has collapsed (landings are 5% of peak landings) in the Northumberland Strait portion of District 8 where source of recruitment may be northern District 8 (D.G. Robinson, pers. comm.). This hypothesis does not explain sustained landings in the latter area.

Published biological information is inadequate to explain the collapse of the fishery in northwestern Northumberland Strait; hypotheses only can be formulated and tested. If, in the interim, economic and marketing studies show that larger lobsters would increase returns to fishermen, then the minimum legal carapace size could be raised. This would have the potential to increase both egg production and yield per recruit. However, it should be noted that a relationship has not been demonstrated in any Canadian lobster stocks between egg production and recruitment.

The season should be moved ahead to a spring fishery or back two weeks to a month to avoid the capture of recently molted lobsters.

In the cooler areas of the southern Gulf, such as Chaleur Bay and the Magdalen Islands, it has been hypothesized that (D.G. Robinson, pers. comm.) egg production per recruit is five to ten times less than in the warmer waters because there is either only one molt or one egg extrusion per reproductively mature female per year. The cyclical patterns in the landings may result from recruitment limited by egg production. This may be due to recruitment overharvesting, fluctuating environmental parameters, or both (see p. 21 for more details on the Québec fishery).

As in District 8, biological data are required on stock recruitment relationships, egg production, survival rates of larvae, juveniles, etc.

---

[1]A.P.M. Verhaart, President of N.V. de Meulencester and Co., Netherlands, lobster importer.

Southeast Coast of Nova Scotia (Districts 4 East, 5, 6a, Southern 6b, 7a)

The harvest has not been sustained and is currently in the third and worst decline in its history (Fig. 3). Given the colder water temperatures compared to the southern Gulf the growth rates here, for all stages, are likely lower. Again, biological data are lacking for this specific area. One hesitates to extrapolate from laboratory work or field data from other areas as this may be a separate population with its own genotypically based characteristics.

Assessments suggest recruitment was sustained during the 1940's when an estimated 5,000 eggs per recruit were produced (Robinson and Pringle, in press). Current calculated production of about 10,000 to 15,000 eggs per recruit suggests the stock is in a recovery mode. This suggests that the recovery rate would be a doubling or tripling of current landings per generation length (eight to ten years). The recovery should be apparent by the early 1980's. Doubled landings are hardly sufficient, considering that landings are now at about 5% of the historical levels. Furthermore, any increase in recruitment biomass will be easily harvested by the available fishing power prior to a significant increase in larval production. Thus, an increase in the minimum legal size to at least 3.5" (8.9 cm) is required. Further biological studies are required to determine if this is sufficient for the entire area.

This fishery has been so reduced that there are stretches of the coast where there is little fishing. It would not be difficult to close some of these areas for scientific research.

Southwest Nova Scotia/Bay of Fundy (Districts 1, 2, 3, 4 West)

There are two fisheries off southwestern Nova Scotia [the Gulf of Maine population (Harding et al., 1983)]: the inshore out to a line of 50 miles, and the offshore which fishes beyond 50 miles (Fig. 1). Management techniques are quite different between the two, although the population status of these stocks is not known.

The inshore fishermen are the best-equipped lobstermen on Canada's Atlantic coast. This permits them to travel farther from port, e.g. to the middle grounds between the inshore and offshore lobster fishery. There is a paucity of information on the distribution of fishing effort in this area (actually in all areas) which confounds any attempt at interpreting the landings. The landings have decreased over the last decade, and if effort has remained stable then one could speculate that lobster density on the inshore grounds has decreased. Size at reproductive maturity and growth rate vary with temperature. Given that this area has the coldest mean annual water temperatures one could hypothesize that growth rates are lower and mortality rates higher than elsewhere in the Maritimes.

Thus, at the present exploitation rates (70% to 80% - Campbell, 1980) and minimum legal size, few lobsters likely survive to reproduce. If the above is the case one could hypothesize that the stock is not self-sustaining and partial recruitment must come from elsewhere.

In the Gulf of Maine little is known about the population biology of lobsters, particularly source and level of recruitment. Thus, it is here recommended that biological research be carried out in particular to define the basic biological units (population).

The most viable option is to raise the legal size in the inshore fishery, which would no doubt allow a greater number of inshore lobsters to reach reproductive maturity. As well, the yield per recruit would increase. This may require a 4" (ca 10.2 cm) legal size.

ENVIRONMENTAL QUALITY

Where lobster stocks have declined significantly, there is little evidence it was caused by environmental degradation (Pringle et al., 1982) through man's activities. The long-term dumping of toxic chemicals is of concern to the well being of the lobster industry. Lobsters, being at the top of the benthic food chain, are likely susceptible to the bioaccumulation of such chemicals. For management to set safe guidelines which are not unduly restrictive of other human endeavours requires the continuation of current control programs plus the accumulation of additional information on which to base future decisions.

The nearshore habitat along Nova Scotia's eastern coast appears to have flipped from a productive macrophyte community to a markedly less-productive microphyte/urchin-dominated community (Wharton and Mann, 1981; Pringle et al., op. cit.). A hypothesis has been proposed which portrays lobsters as a "keystone" predator of urchins in the macrophyte community (Mann and Breen, 1972). The hypothesis suggests that overharvesting of lobsters removed predation pressure from the urchins; their numbers increased markedly as a result. An attendant hypothesis suggests that juvenile lobsters require a lush, macrophyte habitat and that their densities will not increase until the macrophytes return (Mann, 1977). Studies are being carried out (R.J. Miller[2]) to determine the value of macrophytes to commercialy important species.

---

[2]R.J. Miller, Research Scientist, Fisheries Research Branch, Scotia-Fundy Region, Department of Fisheries and Oceans, Halifax, N.S.

Since 1980, there have been massive disease-caused die offs of urchins between Shelburne and Guysborough Counties (Li et al., 1982). Kelp has increased in density and monitoring of the recovery is underway. A review is being written on the relationship between urchin, kelp, and lobster cycles and the role of urchin disease (R.J. Miller, pers. comm.).

NEWFOUNDLAND LOBSTER FISHERY

BRIEF HISTORY

Official records indicate that the lobster fishery began in Newfoundland in 1874, with around 150,000 lb (68 t) landed. Landings increased rapidly to a peak of 17.5 million lb (7938 t) in 1889 (Fig. 6). There were a number of periods of sharp fluctuations in subsequent years around a distinct downward trend, and by 1924 landings had declined to around 750,000 lb (340 t). During these early years the catch was processed in many small canning operations located around the coast (Fig. 7). Although there were regulations defining a minimum legal size and protecting berried females, they were unenforceable and early documentation indicates that virtually everything that was caught was processed.

Following a three-year closure (1925 to 1927), landings increased to 4.6 million lb (2087 t) in 1928; but the recovery was short lived and landings dropped sharply the following year. Starting in the early 1930's, lobsters were shipped live to the U.S. market, where size limit and berried female regulations were strictly enforced. By the early 1950's, virtually all of the landings were shipped live to the U.S. market and the fishery has remained a live-market industry since then. Landings increased to around 5 million lb (2269 t) by 1949, possibly because of increased effort but more likely because of increased recruitment resulting from the degree to which the size limit and berried female regulations were enforceable.

Compared to the dramatic fluctuations in landings which occurred during the earlier years of the fishery, landings since 1949 have been relatively stable. However, the stability has been only relative. From a high of 5.5 million lb (2495 t) in 1955, landings declined to around 2.7 million lb (1225 t) in 1972, which was the lowest level of landings since 1945. Between 1972 and 1979, landings increased dramatically to 5.7 million lb (2586 t), the highest level since 1912. Landings dropped slightly but remained in excess of 5 million lb (2268 t) in 1980 and 1981.

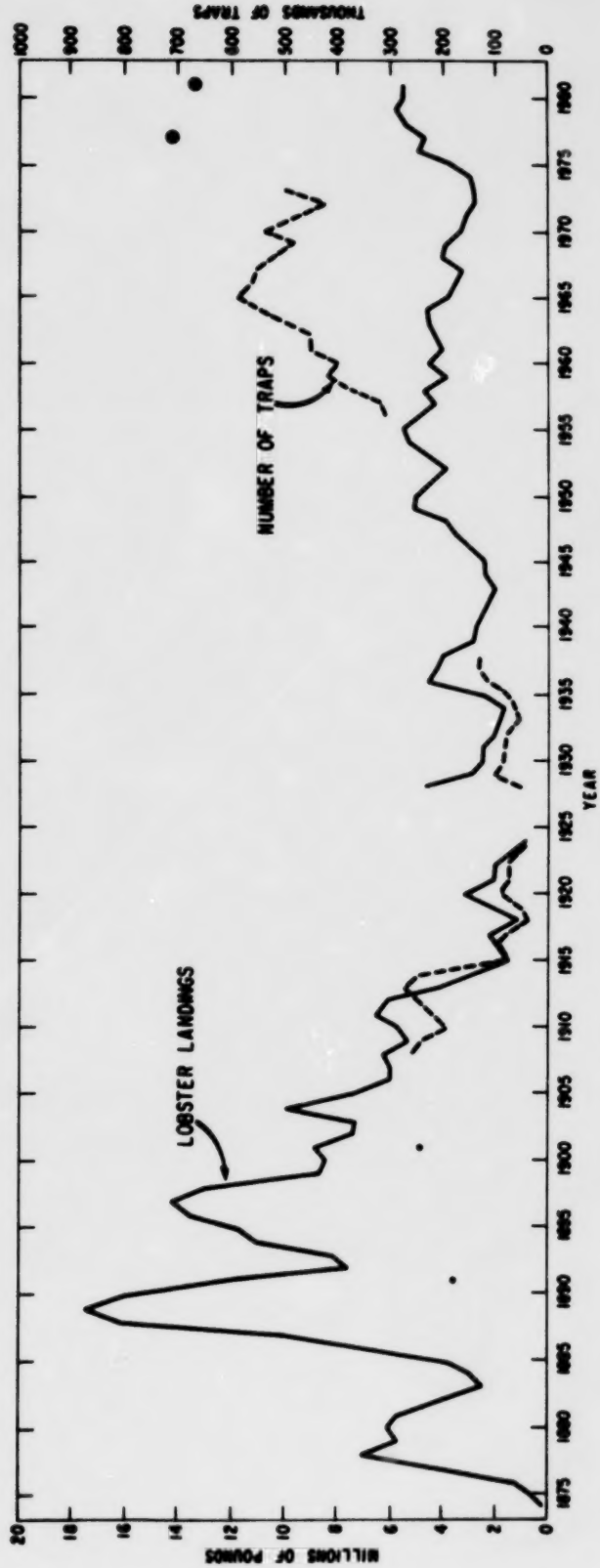

Figure 6. Historical data on landings and effort in the Newfoundland lobster fishery. Circled points indicate the number of traps that licensed fishermen are permitted to use as per the 1976 licensing policy.

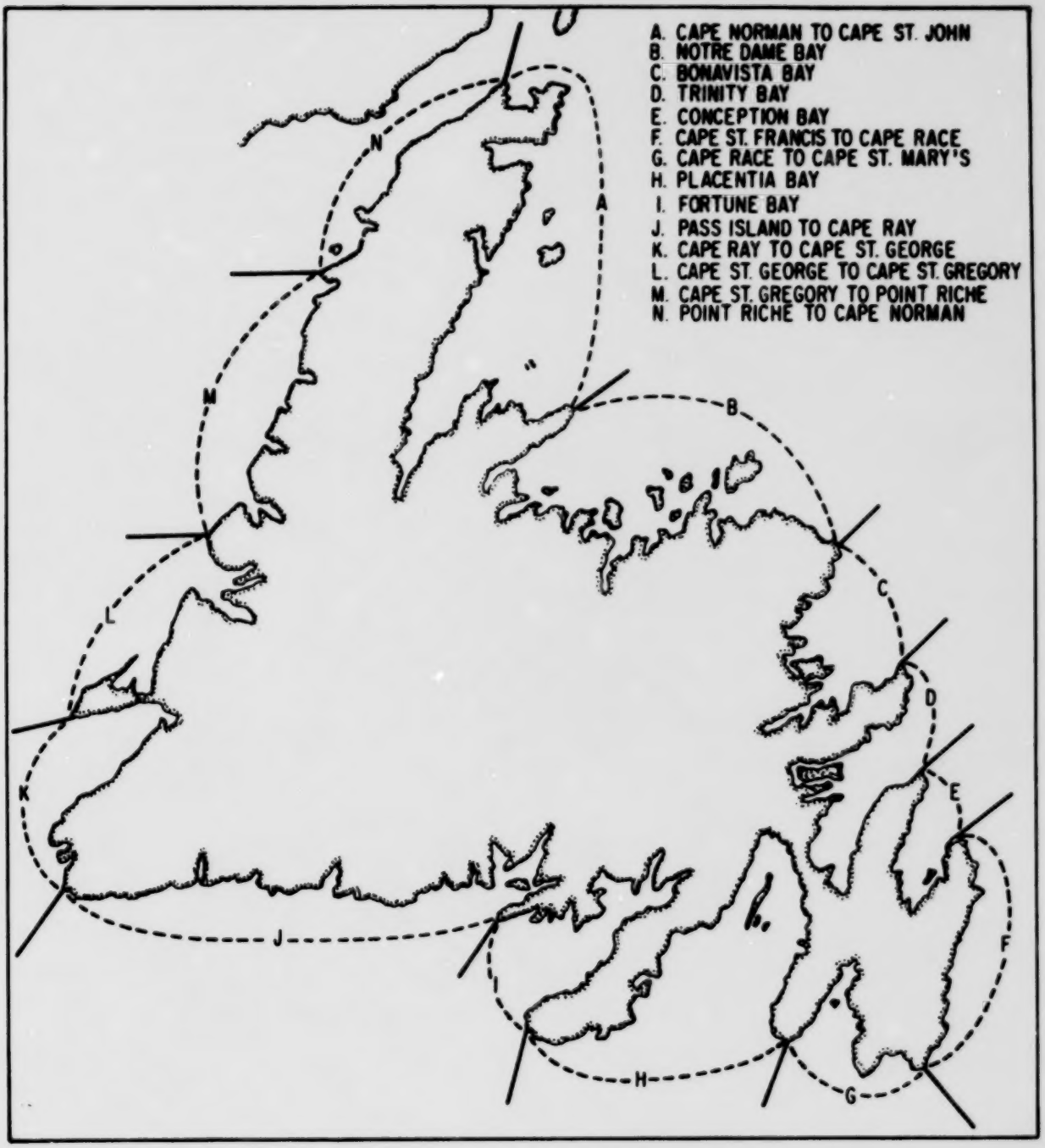
A. CAPE NORMAN TO CAPE ST. JOHN
B. NOTRE DAME BAY
C. BONAVISTA BAY
D. TRINITY BAY
E. CONCEPTION BAY
F. CAPE ST. FRANCIS TO CAPE RACE
G. CAPE RACE TO CAPE ST. MARY'S
H. PLACENTIA BAY
I. FORTUNE BAY
J. PASS ISLAND TO CAPE RAY
K. CAPE RAY TO CAPE ST. GEORGE
L. CAPE ST. GEORGE TO CAPE ST. GREGORY
M. CAPE ST. GREGORY TO POINT RICHE
N. POINT RICHE TO CAPE NORMAN

Figure 7. Newfoundland fisheries statistical districts.

Until 1976, effort in terms of both licences and the number of traps that could be fished per licence was uncontrolled. Effort increased dramatically after 1955 according to the number of traps fishermen stated, on their licence applications, they intended to fish each year. This measure of effort was discontinued after 1973. A limited-entry licencing policy was implemented in 1976. Fishermen who were issued licences were restricted to the number of traps they stated on their 1975 licence applications. This number was far in excess of the 1973 number, and the consensus among fishery officers and fishermen is that the number of traps actually used (which would likely be comparable to the 1973 and earlier effort data) is substantially in excess of the number allowed as per the licencing policy. While the number of licences issued has dropped from 5,410 in 1976 to 4,444 in 1981, the number of traps allowed in 1981 (667,065) is still considerably in excess of the 1973 number; the number of traps actually used has increased substantially over the 1976 to 1981 period.

The dramatic increase in landings (Fig. 6) from 1972 to 1979 has resulted from increased exploitation rates, because of the increase in effort brought about by the increased number of traps in use. Catch rates on the traditionally productive fishing grounds have been reduced. Thus, effort has spread to low or marginally productive areas that previously were not fished or were fished lightly. The contribution to recent landings from this source is likely significant.

Increased landings during the 1970's may have come, at least in part, from increased recruitment. Recent analyses of the time series of data that has accumulated from ongoing studies of lobster population dynamics in the Comfort Cove, Notre Dame Bay, area (Fig. 8) (one of five such localized study areas around Newfoundland) has shown that in this area, despite high exploitation rates, recruitment increased substantially over the 1972 to 1978 period. The cause of this increased recruitment cannot be determined with certainty. Environmental conditions for survival of larvae to settlement or for survival and growth of post-larval and early juvenile stages may have been better than average during the mid to late 1960's. Another possibility is improved conditions (e.g. reduced competition) for growth and survival of early juveniles and prerecruits because of low levels of recruit abundance, as indicated by commercial landings during the early 1970's.

How widespread the increased recruitment was during the 1970's is not known. Substantial increases in landings occurred in Notre Dame, Bonavista, Placentia, and Fortune Bays and along the southwest coast (Statistical Area J) (Fig. 7); but there is no way to determine how much of the increase was due to increased recruitment and how much was due to increased effort.

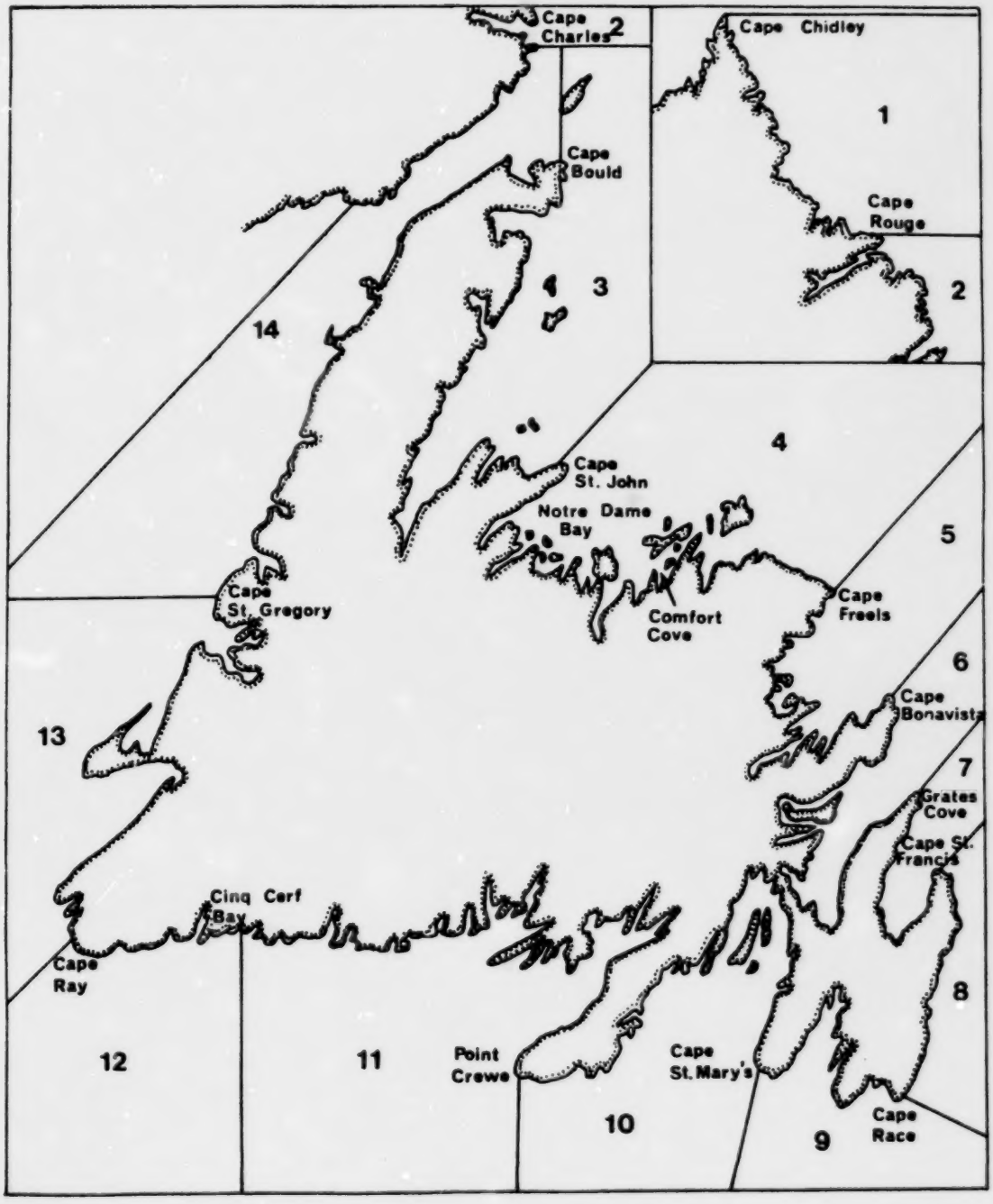

Figure 8. Newfoundland fishery districts.

STATUS OF THE STOCKS

The catch and effort data that are available for the lobster fishery in Newfoundland are not amenable to analysis using surplus yield models, which would give a reliable indication of MSY and associated fishing effort. Possibly, suitable data are only available for the period 1953 to 1973. In addition to the absence of effort data for much of the earlier period, there were substantial changes in the nature of the fishery and in regulatory measures and their enforcement over the first 80 years. Yield per recruit assessments clearly indicate that current exploitation rates are considerably in excess of those that would maximize yield per recruit at the current minimum legal size. In addition, egg production, and presumably subsequent recruitment to the stocks, is substantially less under current conditions than that which would occur with an exploitation rate and minimum legal size that would maximize yield per recruit. There is no doubt that were a surplus yield analysis possible, it would show that current effort is substantially greater than that associated with MSY and current yields are substantially less than MSY.

In some lobster districts the current minimum legal size is below the smallest size at which females lay eggs; and with the very high exploitation rates that generally prevail in lobster fisheries, the possibility of recruitment failure is very real. In Newfoundland waters, however, egg-bearing females as small as 2.6" (6.5 cm) carapace length, well below the minimum legal size of 3.2" (8.1 cm), have been observed and, no matter how high exploitation rates become, a portion of the spawning stock is protected. This begs the question: "does this situation eliminate the possibility of recruitment failure in Newfoundland stocks?" The best answer at the present time is that it is highly unlikely that this minimum level of spawning stock would supply sufficient recruitment for landings to be sustained at recent levels. Landings comparable to recent levels were taken in 1954 and 1955 at considerably lower levels of effort (and presumably much lower exploitation rates), which means that overall abundance (including spawning stocks) was much higher than at the present time. This higher level of spawning stock did not ensure against the decline in abundance that followed during the next 20 years (this does not support the argument for reducing effort and minimum legal size). While it is possible that less-than-favourable environmental conditions for growth and survival of larval and juvenile lobsters prevailed during the period, it is more likely that recruitment overfishing was the basic cause of the decline. Although a substantial proportion of female lobsters within 0.4" (1.0 cm) carapace length below the minimum legal size lay eggs, lobsters at this size have relatively low fecundity; and, as overall abundance declines, the size of the sublegal spawning stocks declines as well. It is clear that the spawning stock protected by the minimum size regulation cannot be relied on to supply sufficient recruitment to prevent a long-term decline in abundance.

Reference was made earlier to the fact that much of the increased effort in recent years has been spreading to low or marginally productive areas that were not fished or were fished very lightly in the past. While lobsters may be relatively scarce in such areas, in the absence of heavy exploitation they would grow to large sizes. Since fecundity increases exponentially with size, and since the majority of these females would have a chance to lay eggs several times before being caught, the relative egg production per female would be far greater than under conditions of high exploitation rates. It is not unlikely that, in the past, at least these "refugia" supplied a substantial proportion of the annual egg production in the population as a whole. Egg production can be increased substantially by increasing the size limit or by reducing exploitation rates. While stock recruitment relationships as well as recruitment mechanisms in lobsters are poorly known, it has to be assumed that, within the limits of the carrying capacity of lobster habitat, increased egg production will result in increased recruitment to the stock. There is no doubt that lobster habitat around Newfoundland is capable of carrying a substantially higher level of lobsters than it does at the present time.

The analysis of data from the study of lobsters at Comfort Cove demonstrates that as much as 91% of the standing stock in a given season was recruited since the preceding fishing season. In any fishery that is so heavily dependent on recruitment, slight variation in recruitment can result in substantial fluctuations in landings from year to year. Even under an ideal fisheries management regime, natural fluctuations in abundance of lobsters (and hence landings) will occur; but under a management regime that is characterized by excessive exploitation rates and a minimum legal size that is too small, fluctuations can be expected to be far more dramatic.

There seems little doubt that if the fishery were scientifically managed, yields from the Newfoundland lobster resource could be sustained at least at recent levels of landings and possibly higher. However, if current conditions continue, all that can be expected over the long term is a downward trend similar to, but probably steeper than, that which occurred between 1955 and 1972. A management plan has been developed along with new districts (Fig. 8); hopefully, remedial measures will be put into effect.

ECONOMIC ASPECTS

During the early days of the Newfoundland lobster fishery, it was regarded by many as only a supplementary fishery. The incomes earned were low; thus fishermen had to distribute their effort among other fisheries, such as salmon and codfish.

However, in recent years demand has increased dramatically for this luxury commodity. This strong market demand and consequent high prices (relative to other important inshore species), coupled with the marketing of live lobsters, through better transportation systems, resulted in dramatic increases in fishing effort in what was an open-entry fishery. This situation was further accelerated by a lack of alternative employment opportunities, low (additional) capital requirements for entry, and a low level of additional skills required for lobster fishing. All of the above characteristics or conditions, when combined with an ubiquitous resource and the localized nature of the fishery, resulted in an intensive fishery with excessive inputs of labour and capital. Today approximately 85% to 95% of available, commercially legal lobsters are harvested annually. Concern over resource depletion and excessive inputs of capital and labour resulted in the lobster fishery being given limited-entry status in 1976.

The lobster fishery today is characterized as one of economic inefficiency because present catch levels could be harvested with much smaller inputs of labour and capital investment in boats and gear. Therefore, in the aggregate, the benefit of comparatively high prices received for lobsters tends to be negated by high costs of fishing.

Currently in Newfoundland there are 4,444 licenced lobster enterprises that are licenced to fish 667,065 traps. The lobster fishery is identified with numerous small-scale enterprises, each comprised of one- or two-man crews operating with small, open outboard-powered boats. Inboard gasoline and diesel engines, however, are still in use in some locations on the island. The vast majority of these boats range from 17' (5.2 m) LOA to 22' (6.7 m) LOA and prosecute a lobster fishery that is strictly inshore in nature.

The lobster fishery accounts for approximately 15% to 20% of landed value of the inshore sector [enterprises with vessels 35' (10.5 m) LOA]. The average price per pound of lobster has risen consistently each year from $1.06 in 1976 (year of limited entry) to $2.04 in 1981. The price per pound received on the local sales market is even higher and in 1981 ranged from $2.50 to $3.25 per live pound. Local sales comprise annually about 7% to 9% of total landings.

In summary, while the number of licenced enterprises has declined about 20% since the advent of limited entry in 1976, there still remains, from an economic standpoint, excess fishing effort in the form of labour and capital. Further reductions must occur in order to improve the net economic returns from an annual yield at recent catch levels [approximately 5.3 million lb (2400 t)].

Fishing effort is already intensive. Its further intensification (number of traps, trap hauls, and hours worked) can only increase total fishing costs while adding little to total output. The Newfoundland Region Lobster Advisory Committee has recommended that the "optimum" level should be approximately 2,124 licences and 423,000 traps for all districts in total (Fig. 8) (it should be noted that enforcement of effort in a trap fishery has rarely been proven successful anywhere on Canada's Atlantic coast). An economic optimum is not yet available, lacking an adequate costs and earnings data base.

QUÉBEC LOBSTER FISHERY

BRIEF HISTORY AND STOCK STATUS

For this report, the Québec lobster fishery was divided into the Magdalen Islands (Districts 9a and 9b; Fig. 1) and the Gaspé-Bonaventure areas (Districts 10c and 10d). Landings and fishing effort up to 1971 were published (Bergeron, 1967; Billette, 1971). The landings between 1875 and 1917 were originally recorded as pounds of canned lobster; thus, a coefficient of 18.5% (Rutherford et al., 1967) was employed to convert canned lobster weight to live fresh weight.

Gaspésie and Bonaventure

The official reports indicate that commercial lobster fishing started in Québec (Bergeron, 1967) in Bonaventure County in 1871. Bonaventure and Gaspé catches increased quickly to reach a peak of 2.4 million lb (1.1 million kg) in 1880 (Fig. 9). After some fluctuations, there were two dramatic decreases - 1900 and 1913. The latter was followed by a steady decrease which bottomed out in 1939 at 140,317 lb (63636 kg). From 1939 to 1975 there was a gradual increase in catches, while from 1975 to 1981 landings increased rapidly to reach 1,082,435 lb (490900 kg) in 1982, a level comparable to that of the 1901 to 1912 period.

From 1897 to 1945 there was a general decrease in the number of traps employed, a response, no doubt, to decreasing catches. Following the marked decreases in landings in 1900 and 1913 there were concomitant decreases in effort.

There was a reported increase in the number of traps used between 1950 and 1971, while the catches were only slighly higher. In fact, it is probable that for this period the number of traps was overestimated. Indeed, despite an important increase in the number of fishermen between 1950 and 1971 (Bureau de la statistique du Québec, 1950-1971), it is difficult to conclude a proportional increase in the number of traps used

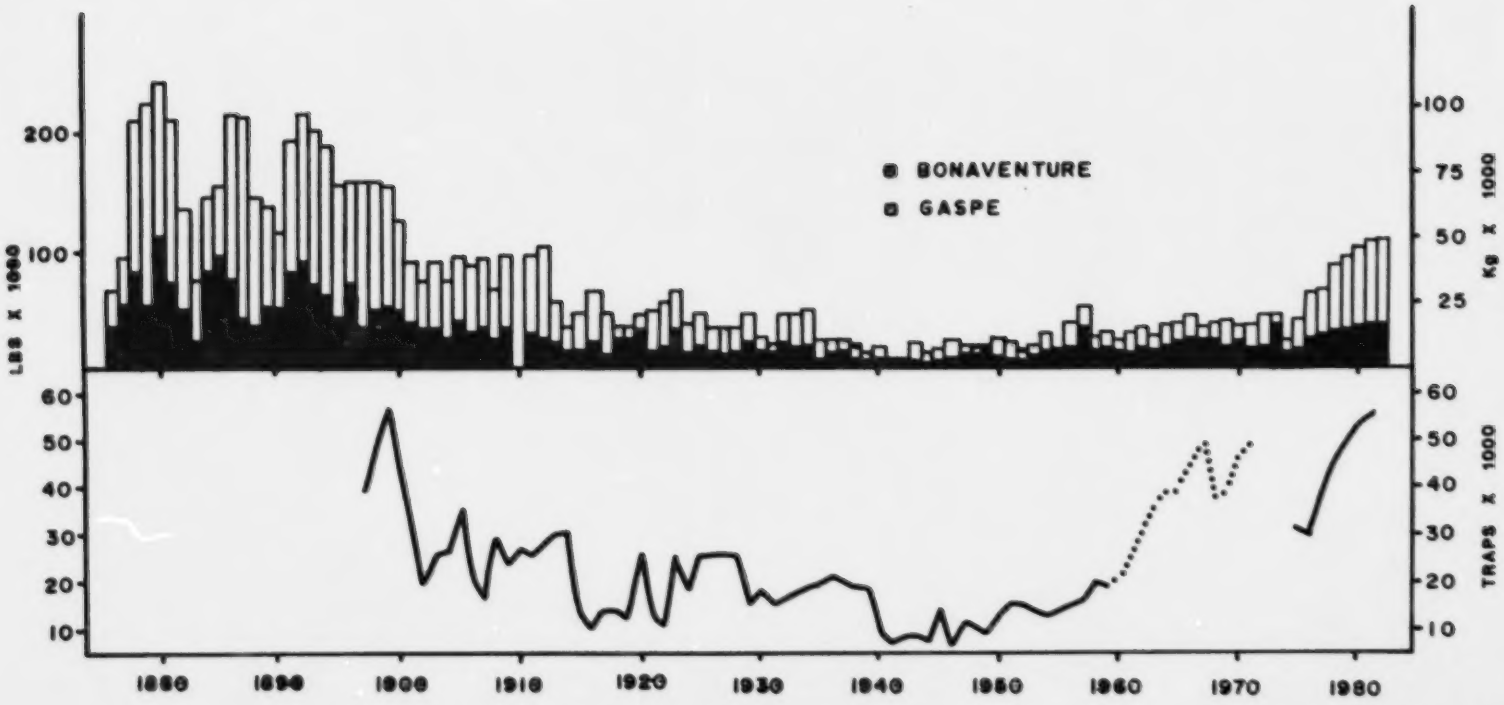

Figure 9. Annual landins and total number of traps used per season in the districts of Gaspé and of Bonaventure, from 1876 to 1982.

as many did not fish lobsters or if they did, they only used a limited number of traps. Belzile (1981) points out that since 1970, lobster fishing developed considerably due to the legislation forcing the use of a minimum of 100 traps. As a result, part-time fishermen were slowly eliminated. Fishing became more professional from 1975 to 1981 with the number of traps used per fisherman approaching the maximum allowed (250 traps); fishing effort thus increased by 150% (Belzile, 1981). During this period, landings increased from 450,316 lb (204225 kg) in 1975 to 1,187,388 lb (538498 kg) in 1981 (Table 2).

Magdalen Islands

Official reports indicate that lobster fishing started in 1875 on the Magdalen Islands. The fishery that had been developing for five to six years in Chaleur Bay was almost unknown to fishermen on the Magdalen Islands (Lavoie, 1877). Based on the landings it appears that the fishery developed more slowly than in Gaspésie (Fig. 10). Even while experiencing wide fluctuations, catches increased until around 1911, reaching a record of 4,793,357 lb (2173858 kg) in 1905. As in Gaspésie, landings declined between 1914 and 1942, bottoming out at 1,584,394 lb (718546 kg).

The pattern of annual landings of the Magdalen Islands resembles that of the overall Canadian landings for the last 60 years (Fig. 2; Fig. 10). In both cases, there was a peak in landings around 1932, followed by a decrease around 1940, an increase until 1962, and another decrease until 1972. This similarity is even more interesting, since the Magdalen Islands contributes only 4% of the total Canadian landings. This phenomenon suggests that the observed variations in catches respond to certain common parameters which are likely not solely fisheries connected. According to Dupont and Boudreault (1976), one of the main factors influencing landings on the Magdalen Islands is water temperature. Their model predicts lobster landings by quantifying three variables: the previous year's landings, water temperature of the month of December nine years earlier [a factor affecting larvae survival (Templeman, 1936, cited by Dupont et al., 1976)], and the winter temperature of the previous year which no doubt plays an important role, particularly for juveniles, as a higher temperature increases the proportion of molting lobsters (Ennis, 1981). This should result in a larger number recruited to the fishery. The effects of temperature on landings is obvious in the Magdalen Islands (Fig. 10): between 1939 and 1958, both the mean water temperature and the landings increased. The minimum legal carapace size used from 1940 to 1957 (Table 3) offered little protection to mature females; despite this, landings increased. This increase could be attributed to many factors, including increased mean water temperatures. During the period 1954 to

Table 2. Lobster landings and number of fishermen in the three lobster regions of Quebec from 1975 through 1981.

Year	Bonaventure		Gaspé		Iles-de-la-Madeleine		Total	
	Fishermen	Landings (kg)	Fishermen	Landings (kg)	Fishermen	Landings (kg)	Fishermen	Landings (kg)
1975	-	77698	108	126827	321	975230	-	1179759
1976	77	119502	115	177308	300	998141	492	1294951
1977	78	147932	126	241714	301	1079728	505	1469374
1978	80	152579	136	280521	309	1110852	525	1543952
1979	81	166190	132	314744	328	1215561	541	1696495
1980	86	178016	130	342109	328	1021551	544	1541676
1981	87	183482	130	355016	328	1133981*	545	1672479
Totals:	489	1025399	877	1838239	2215	7535044	3152	9218927
Mean:	81.5	170900.0	125.3	262605.6	316.4	1076434.9	525.3	1536487.8
CPUE:	2096.9		2095.8		3402.1		2925.0	

*Provisional

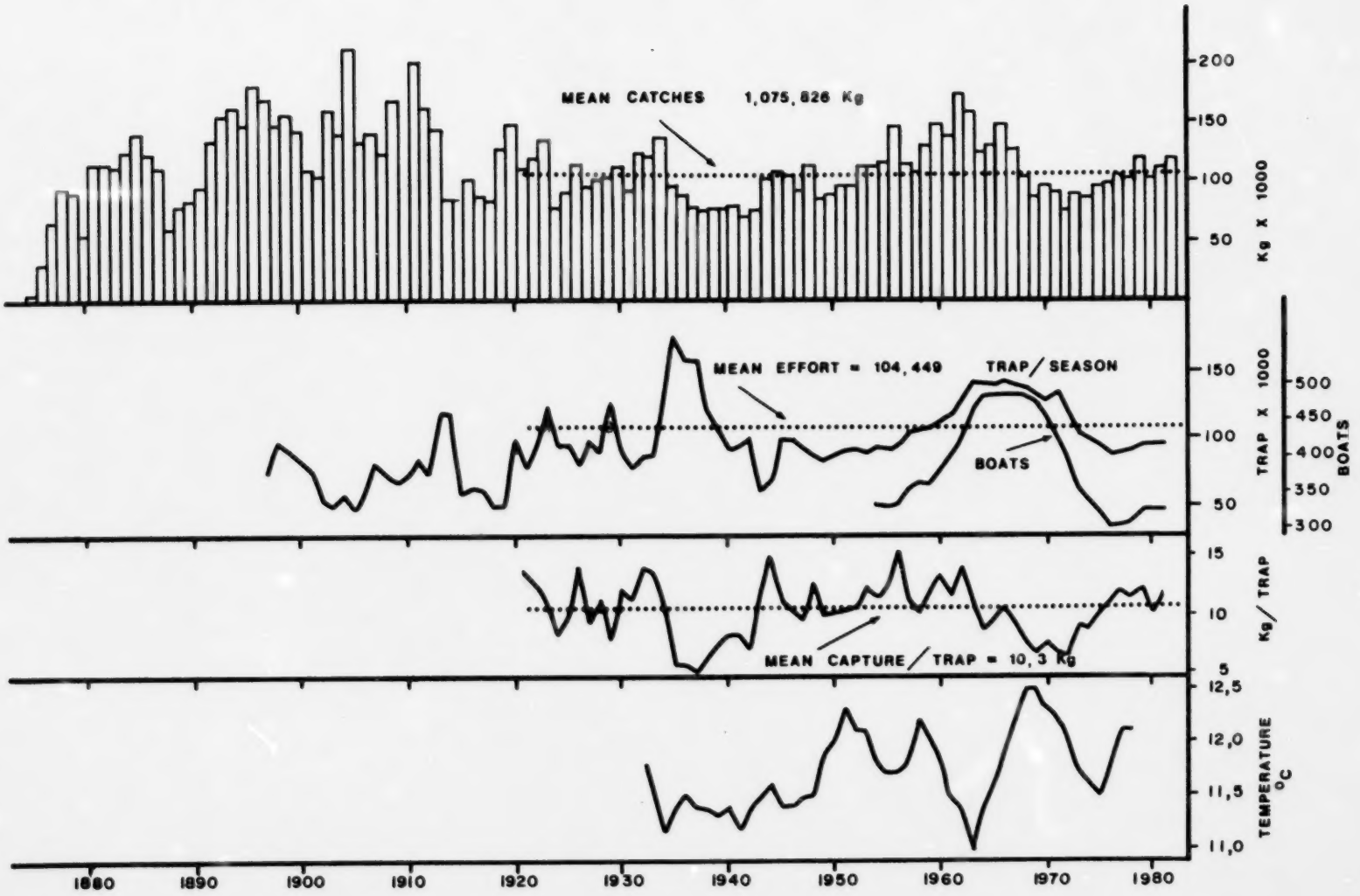

Figure 10. Annual landings, total number of traps used per season, catches per trap and per season at the Magdalen Islands from 1875 to 1982 and mean surface temperature, every five years, between May and July at Entrée Island and Magdalen Islands.

Table 3. Lobster fishing regulations in Magdalen Island and Gaspé.

Year	Legal size	Fishing season	Other
1874	TL (total length): 9" (22.9 cm)	No fishing in July and August	Berried females prohibited.
1886-1898		January 1 to July 15	
1894			Fishing prohibited in Magdalen Islands lagoons.
1898	TL: 8" (20.3 cm)	May 1 to August 1 (Magdalen Islands) April 20 to July 10 (Gaspé)	
1908			Seine prohibited in Gaspé.
1940	TL: 6" (15.2 cm), 5" (12.7 cm)		
1942	TL: 7" (17.8 cm)		Lath space of 1-1/4" between the two lowest side laths.
1953	CL (carapace length): 2-1/2" (6.35 cm)		
1954	CL: 2-5/8" (6.68 cm)		
1955	CL: 2-3/4" (7.0 cm)		
1956	CL: 2-7/8" (7.2 cm)		
1957	CL: 3" (7.6 cm)		
Actual		May 10 to July 10 (Magdalen Islands) May 1 to July 1 (Gaspé)	Magdalen Islands: max. of 300 traps; Gaspé: max. of 250 traps, min. of 100 traps.

1957 present minimum carapace lengths were gradually employed [3" (7.6 cm)]; landings peaked approximately one generation later (1962). This increased catch was not sustained, however, as landings decreased from 1968 onward. Other factors such as water temperature decreases from 1959 onward, plus a high level of fishing effort, may have been responsible for the decline. From 1920 to 1982, fishing effort appeared to fluctuate in response to catches. For example, increased catches around 1934 and 1962 were followed by a marked increase in fishing effort. In spite of this, catches often decreased immediately afterward and the observed decrease was due to a decrease in CPUE. During this period, the returns from fishing were inversely related to fishing effort (Fig. 11). If we consider CPUE as a measure of lobster abundance, then an increase in fishing effort leads to a decrease in lobster abundance.

IMPROVING ECONOMIC RETURNS

The primary economic aim of the Department of Fisheries and Oceans is to maximize return to the industry on a long-term, sustained basis. To permit this, management must develop a mix of regulations controlling size, season, and quality. There may be a significant potential in the lobster industry to increase economic returns, as shown below.

The average landings from Lobster Districts 4 and 8 for the last three years have been roughly similar [7.2 million lb (3266 t) vs 6.7 million lb (3039 t) respectively]. The average lobster landed in District 4 weighs twice that of the average lobster landed in District 8 [ca 1.3 lb (0.59 kg) vs 0.65 lb (0.30 kg)]. Thus, District 8's production in numbers is about twice that of District 4. The average value of the District 4 landings for the same period, however, has been about double the District 8 value ($19.3 million vs $9.5 million). Thus, the return per recruit to fishermen in Lobster District 4 is about four times greater than in Lobster District 8. However, it must be pointed out that geography plays an important role in this analysis. First, southwest Nova Scotia has the only winter season which is possible because of climatic conditions (the southern Gulf is covered with ice between December and April). Second, southwest Nova Scotia is closer to the lucrative Boston and New York markets. Nevertheless, the analysis demonstrates that the setting of minimum sizes, seasons, etc. could be extremely important in optimizing returns.

INCREASING YIELDS

There is little doubt that the bulk of the lobster stocks in Atlantic Canada are growth overfished. It has been hypothesized that they are recruitment overfished as well.

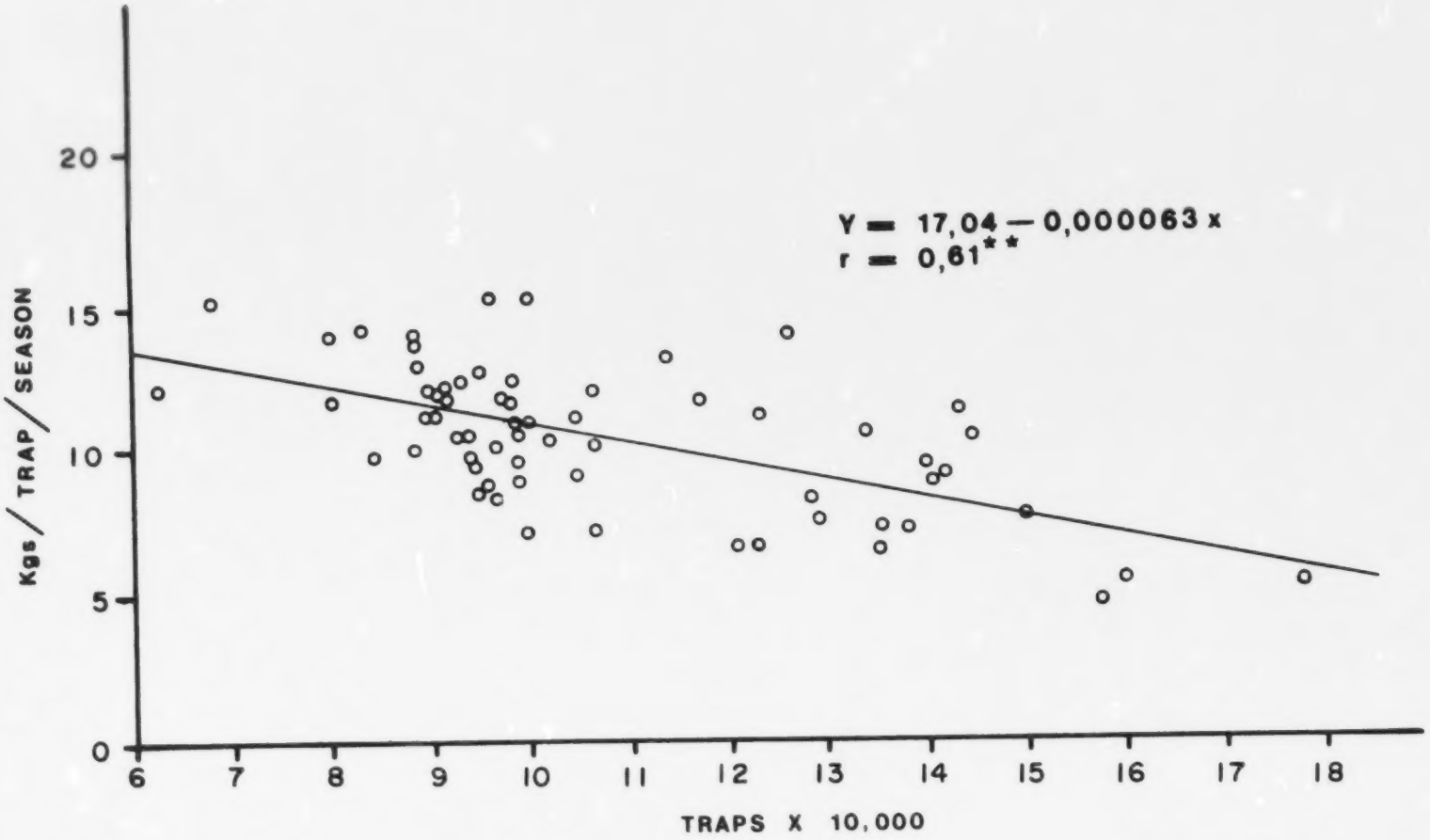

Figure 11. Relation between fishing return per trap, per season, and fishing effort, at the Magdalen Islands, for the period of 1930 to 1981. (The annual returns correspond to catches divided by the total number of traps used at the beginning of the season.)

Analyses of a number of stocks have demonstrated that yield per recruit would be enhanced if minimum legal carapace lengths were increased. This would, no doubt, increase egg production; some argue that it is logical to assume an increase in recruitment - nowhere has this been demonstrated scientifically.

LOBSTER MARKETING

Given the nature and size of the lobster fishery the industry should, theoretically, be able to supply the appropriately sized animals at the time of peak demand. The present fishing seasons and minimum legal lobster sizes were set many years ago, presumably to meet market demands of that era. Markets may have changed in the interim, which would suggest that changes in seasons fished and minimum legal carapace size should be contemplated. Industry (government included) should agree to changes where the economic incentives are demonstrable. Information on both marketing and the economics of any projected changes are required so that the total industry can make decisions based on knowledge.

Market Trends

Until recently, lobster marketing could conveniently be described as live sales to northeastern U.S. brokers and canned meats sales to the U.S. and other markets (Table 4a and b). Successful Canadian marketing initiatives of the last few years have developed and employed the following general principles:

1) The clawed lobster (genus Homarus) in the shell, whether live or frozen whole, is a product unique to world markets. On the other hand, lobster meat extracted from the shell must compete with vast quantities of other crustacean meat products;

2) Clawed lobster in the shell commands luxury food prices, relative to other crustacean meat products, chiefly because of the "reflected glamour" from the in-shell product;

3) Live lobsters may be transported readily under specified conditions, the principal one being that they be returned to sea water within about 24 hours. Live sales were once only restricted to northeastern North American markets when trucking was the major means of transport. Rapid and reliable air transport, with stopovers in western Canada and western Europe for lobster recovery,

Table 4. The Canadian export of lobsters to the U.S.A., Europe, and other countries between 1977 and 1980.

Table 4a. Canadian exports, lobster in shell (,000 lbs).

	1977	1978	1979	1980	1981
U.S.A.	13,808	12,658	16,372	15,719	16,414
Europe	2,009	4,371	7,320	8,204	9,051
Other	819	466	130	246	237
Totals:	16,636	17,495	23,822	24,168	25,702

Table 4b. Canadian exports, lobster meat frozen (,000 lbs).

	1977	1978	1979	1980	1981
U.S.A.	2,606	2,840	2,161	3,117	2,877
Europe	234	404	1,385	728	946
Other	70	57	6	31	63
Totals:	2,910	3,301	3,553	3,876	3,886
Total Canadian Landings:	39,312	42,074	47,569	44,286	47,800

has opened the world as a potential market. New markets have been developed now because of recent efforts;[3] and

4) Northeastern U.S. (Table 5) and western Europe (Table 6) are the only other areas in the world where clawed lobsters are produced. They are, however, net importers of lobster in the shell. This leaves Canada to play a dominant role in supplying these and other distant markets. Fisheries in the U.S. and Europe are open year round, with the majority of landings occurring in the warm July to November period.

Canada, with multiple seasons, has the potential to supply a high-quality product throughout the year. Thus, economic yields from the fishery may be increased by focusing marketing initiatives on distant, luxury trade for in-shell products (live or frozen).

Seasonal Supply

It has been alleged by one of the major Canadian exporters of live lobsters that in the major markets now supplied there is little seasonal swing in demand, with the exception of the Christmas period. There is considerable seasonal fluctuation in supplies, however (Table 7), which affects availability and hence price. Significant features to note in the present supply and demand picture are: the high prices from December to April when few fisheries operate; the May to June glut in supply caused by the opening of most Canadian fisheries (Table 7); the effect of this glut on prices (Table 8); and the "summer rebound" in prices, particularly with the development of distant markets.

The lobster fishery is the backbone of the inshore fishery; however, few, if any, lobstermen derive their total income from it. First, the returns are insufficient; and second, it is persued for a few weeks only. Consequently, ancillary fisheries are enmeshed with the lobster season. Changing seasons of any of these fisheries, particularly lobster, would be a complex undertaking. Obviously, prior to doing it, hard economic data are required. Given that changes are economically viable to the harvester, the following options might be considered:

1) Encourage winter fishing only where this is viable;

---

[3]Total value of exports increased from $75 million in 1978 to $102 million in 1980; the bulk of this ($24 millon) came from the increase in value of in-shell products exported.

Table 5. Monthly U.S.A. landings of American lobster, 1979 to 1981 (million pounds, live weight).

Month	1979	1980	1981	1982
January	0.4	0.6	0.5	0.6
February	0.1	0.2	0.3	0.3
March	0.3	0.2	0.3	0.3
April	0.7	0.6	0.6	-
May	1.5	1.4	0.7	-
June	1.9	1.5	1.5	-
July	4.2	3.9	4.0	-
August	6.1	5.2	4.7	-
September	6.5	4.9	4.3	-
October	5.7	4.3	4.3	-
November	3.6	2.8	2.9	-
December	1.6	1.6	1.8	-
Total Major Ports:	32.6	27.2	25.9	-

Table 6. Landings of European lobster by country (,000 t nominal weight). Source: FAO.

Country	1975	1976	1977	1978	1979	1980
France	0.4	0.3	0.4	0.4	0.4	0.3
Eire	0.3	0.4	0.3	0.3	0.3	0.3
Norway	0.1	0.1	0.1	0.1	0.1	0.1
England and Wales	0.3	0.3	0.4	0.3	0.3	0.3
Scotland	0.5	0.5	0.5	0.5	0.5	0.4
Other	0.2	0.3	0.2	0.2	0.1	0.4
Totals:	1.8	1.9	1.9	1.8	1.7	1.8

Table 7. The Canadian monthly lobster landings for the years 1977 to 1981.

Month	Monthly landings (t)					Seasonal Distribution of Catch (%)
	1977	1978	1979	1980	1981	
January	196	106	171	231	123	0.8
February	45	69	14	26	70	0.2
March	361	48	111	70	164	0.8
April	1229	866	1010	951	585	4.7
May	6496	7219	8581	8296	6915	37.9
June	4677	5182	5889	5275	3811	25.1
July	723	800	459	476	3242	5.8
August	1331	1868	1779	1745	1687	8.5
September	880	1026	1077	1054	1660	5.8
October	216	291	310	278	808	1.9
November	504	416	568	526	364	2.4
December	1165	1287	1611	1161	866	6.2
Totals:	17832	19178	21577	20089	20295	

Table 8. Mid-monthly live lobster selling prices from Maine and Massachusetts to wholesalers in New York.

Month	Price (U.S. $)			
	Selects (2 lbs)	Halves (1.5 lbs)	Quarters (1.25 lbs)	Chicks (1 lb)
1981:				
January	5.60-5.65	5.45-5.50	5.50-5.10	5.05-5.10
February	6.25-6.30	5.80	5.50	5.30
March	6.00-6.05	5.80-5.85	5.00-5.05	5.00-5.05
April	6.15-6.20	5.15-5.20	4.80-4.85	4.50
May	3.80-3.85	3.70-3.75	3.25-3.30	3.25-3.30
June	3.40	3.30	3.20	3.15
July	3.65	3.65	3.65	3.65
August	4.50-4.55	4.35-4.40	3.80-3.85	3.45
September	5.25	4.85-4.90	3.65-3.70	3.55-3.60
October	4.55-4.60	3.75-3.80	3.40	3.35-3.40
November	4.60-4.65	4.10-4.15	3.40-3.45	3.35-3.40
December	4.65-4.70	4.35-4.40	3.75-3.80	3.75-3.80
1982:				
January	4.95-5.00	4.45-4.50	3.85	3.85
February	5.30-5.35	4.90-4.95	4.35-4.40	4.35-4.40
March	6.00	5.45-5.50	4.85-4.90	4.85-4.90
April	6.90-6.95	6.20-6.25	6.00	5.95-6.00
May	3.55	3.55	3.55	3.55
June	3.55	3.55	3.55	3.55
July	3.90-3.95	3.90-3.95	3.85-3.90	3.85-3.90
August	5.85-5.90	5.25-5.30	4.25-4.30	4.10-4.15
September	6.00-6.50	5.00-5.10	4.20-4.25	4.05-4.10
October	4.70-4.90	4.30-4.40	3.50-3.55	3.35-3.40
November	4.65-4.75	4.20-4.25	3.65-3.70	3.60-3.65
December	4.15-4.20	3.85-3.90	3.55-3.60	3.55-3.60

2) Encourage summer (July/August) fishing where hard-shelled lobsters are available during this period; and

3) Encourage late-fall fishing (there is a paucity of lobsters at this time) in an area such as District 8.

Lobster Size and Demand

Lobsters are marketed by size, and this accounts in part for the legal sizes which exist in Canada today. The legal size limit plus the intensity of the fishery determines the range of sizes and the volumes available for marketing.

The intensity of the modern fishery in all productive areas manifests itself in a catch where the majority of lobsters captured are newly recruited to the legal size. Few escape capture to grow to larger sizes. The range of sizes supplied from any one area tends to be dominated by the minimum legal size. This results in an adequate supply of lobsters with a 3.2" (8.1 cm) carapace measure at certain times of the year only, an oversupply of lobsters with a 2.5" (6.4 cm) carapace measure at certain times of the year only, and a shortage of larger individuals [greater than 3.5" (8.9 cm) CL]. Due to the fishing intensity, larger lobsters tend to form a small part of the total catch in productive areas. Exceptions to this pattern are:

1) Spring fisheries of the southern Gulf of St. Lawrence (e.g. part of District 7b1); and

2) Areas of low effort and low productivity where there may be a higher rate of survival to larger sizes (e.g. central Northumberland Strait, southeast coast of Nova Scotia, upper end of Bay of Fundy). In the offshore and midshore fisheries off southwestern Nova Scotia, the larger mean size of lobsters may be due to a recent increase in effort. Unfortunately, the catch from such areas represents a small portion of the total landings for the Atlantic fishery.

Unfortunately, a marketing analysis of supply and demand trends for lobsters is not available. One of the authors (D.G. Robinson - biologist) has gathered the following information together over a period of years.

Demand is low for lobsters in the 2.5" (6.4 cm) (see Table 9 for sizes) to 3" (7.6 cm) carapace length, [0.45 lb (204 g) - 0.75 lb (340.5 g)] size range. Demand increases rapidly beyond 3" (7.6 cm) carapace length (Table 9) and remains high to 4" (10.2 cm) carapace length (2 lb or 980 g). Demand is

Table 9. The length and range of sizes for each lobster marketing size group (1-9).

Size group	Range of sizes			Marketing term
	mm	Inches	Pounds	
1	64-70	2.5-2.75	0.45-0.60	small canners
2	71-76	2.75-3.0	0.60-0.75	medium canners
3	77-82	3.0-3.25	0.75-1.0	large canners, choice
4	83-89	3.25-3.5	1.0-1.25	chicks - quarters
5	90-95	3.5-3.75	1.25-1.5	quarters - halves
6	96-102	3.75-4.0	1.5-1.9	halves - 3/4's - selects
7	103-108	4.0-4.25	1.9-2.2	selects
8	109-127	4.25-5.0	2.2-3.5	large markets
9	> 128	> 5.0	> 3.5	jumbos

good for the 4" (10.2 cm) to 5" (12.7 cm - 3.5 lb or 1.59 kg) size range, after which it decreases rapidly. Highest prices are paid for lobsters around 2 lb (0.91 kg) in weight ("selects").

Table 9 gives the market size groups. It can be seen that supply from the fisheries is poorly matched to demand (compare Table 11 with Tables 8 and 10). Approximately 43% of the total Canadian supply is in the two smallest size ranges. Less than 10% are in the size ranges for which demand is highest (Tables 8 and 10).

The imbalance is reflected in wharf prices paid to fishermen. Recent values, on a per-pound basis, are as follows: Canners - $1.20-$2.10; Choice (see Table 9) - $1.70-$1.80; Markets - $2.25-$5.00 (seasonal swing significant); and Jumbos - $1.50-$2.00. The higher price received at the wholesale level for progressively larger markets up to the select size is not distinguished at the wharf level, as it tends to be averaged in with the more abundant smaller sizes.

Size limit increases in Newfoundland, the Gulf of St. Lawrence, Nova Scotia, and southern New Brunswick would translate into gains in terms of biological yield per recruit. A first option would be to increase minimum legal size in both the warm-water stocks (southern Gulf of St. Lawrence) and the cold-water stocks to 3.0" (7.6 cm) and 3.5" (8.9 cm) respectively. The projected supply of the various size classes, were this option enacted, is given in Table 12. Marketing and economic assessments are required, however, to ensure the economic viability of this scheme.

Lobster Quality

A higher level of quality control is required to ensure that the bulk of the harvest is marketed at the highest level (that which will bring the best price at the time of marketing currently live lobsters). Either a regulatory approach or a strategy of education and incentive may be employed to bring about the following changes:

1) Prerecruit damage and mortality can be reduced by escape vents in traps;

2) The percentage of undamaged lobsters in a catch is increased if claws are immobilized upon removal of the lobster from the trap. Rubber banding causes less injury than pegging or cutting. Trials with adhesive tapes have shown that these are more effective than rubber bands, but a rapid applicator is not available.

Table 10. Wholesale lobster prices (CDN $/lb) from the New York Fulton Market - October 1, 1981, 1981, and 1982.

Lobster size	Market term	Price		
		1980	1981	1982
1 lb (454.0 g)	Chix	3.80	4.16-4.22	4.69-4.76
1-1/4 lb (567.5 g)	Quarters	3.91	4.22-4.28	4.76-4.82
1-1/2 lb (681.0 g)	Halves	4.68	4.76-4.82	4.94-5.06
2 lbs (908.0 g)	Selects	5.09-5.15	5.79-5.85	6.18

Table 11. Approximate 1979-1980 lobster landings, in millions of pounds by size groups, for Atlantic Canada (Size Groups 4-8 include the traditional "market" category).

Lobster District	Size group									Total
	1 (64-70 mm)	2 (71-76 mm)	3 (77-82 mm)	4 (83-89 mm)	5 (90-95 mm)	6 (96-102 mm)	7 (103-108 mm)	8 (109-127 mm)	9 (> 128 mm)	
1, 2, 3, 4				6.3		2.0		0.4	0.4	9.1
5, 5A, 6A, 7A				0.1		0.1		0.05	0.05	0.3
6B		1.5		0.4		0.2				2.1
7B, 7C, 8	19.0		3.8		0.7		0.2			23.7
9, 10			2.9		0.8		0.4			4.1
11-14				4.0		1.2		0.3	0.2	5.7
Size group totals:	9.5	10.3	4.1	8.7	6.2	2.5	2.1	1.0	0.7	45.0
Percentages:	21	23	9	19	14	6	5	2	1	

Table 12. The potential supply per season, in millions of pounds, for each weight range of lobsters were minimum legal size limits increased to 3.0" (76.2 mm) and 3.5" (89.0 mm) in warm-water stocks (southern Gulf) and cold-water stocks respectively.

Fishery type	Weight range of catch (lbs)				Total
	0.75-1.25	1.25-1.75	1.75-2.5	2.5	
Fall, warm	9.6	1.8	0.6	-	12
Fall/winter, cold (Districts 1-4)	-	12.0	2.3	0.7	15
Spring, warm (Districts 7b and 7c)	19.2	3.6	1.2	-	24
Spring, cold (Districts 6a and 6b, 7a and 11-14)	-	21.6	4.1	1.3	27
Totals:	28.8	39.0	8.2	2.0	78

3) On-board holding tanks with flow-through water would reduce losses and maintain the lobsters in excellent condition. This is especially beneficial for warm-water fisheries;

4) Pre-weighed traps or trays covered with wet burlap would reduce handling during the "boat-to-plant" unloading;

5) The need for long storage periods by Canadian buyers, and the attendant problems of capital costs and potential loss through disease, could be reduced by adjusting the fishing season to better match market demand;

6) The bacterial lobster disease, Gaffkaemia (often called redtail), can be a major cause of loss during storage and shipping. A monitoring program for freshly captured lobsters, in-plant sampling, a certification program, improved diagnostic techniques, and development of productive measures are required;

7) Improvements in design and operation of lobster-holding units are urgently required if the relatively high losses in this part of the operation are to be reduced or avoided; and

8) Lobsters may be landed in a "soft-shell" condition. The meat yield and survival during shipping of such animals is poor. Knowledge gained through scientific studies on disease, growth, and reproduction, as well as culture operations, could be employed through fattening up programs to cope with this problem.

GENERAL DISCUSSION

MANAGEMENT ADVICE

Lobsters have been fished commercially on the Atlantic coast for over 100 years. There is little doubt that by 1900, most stocks had received extensive fishing pressure (Fig. 2). Landings have not returned to turn-of-the-century levels in spite of increased fishing effort. It is unlikely that the catches could ever return to previous maximums as they were the result of fishing virgin stocks. However, with improved management, landings could be increased markedly. The landings have fluctuated in certain areas in the recent past (Figs. 3 to 6), but overall since 1955 they have remained remarkably stable (Fig. 9). The amount paid per unit of harvest, however, has increased three-fold in the last decade (Fig. 12).

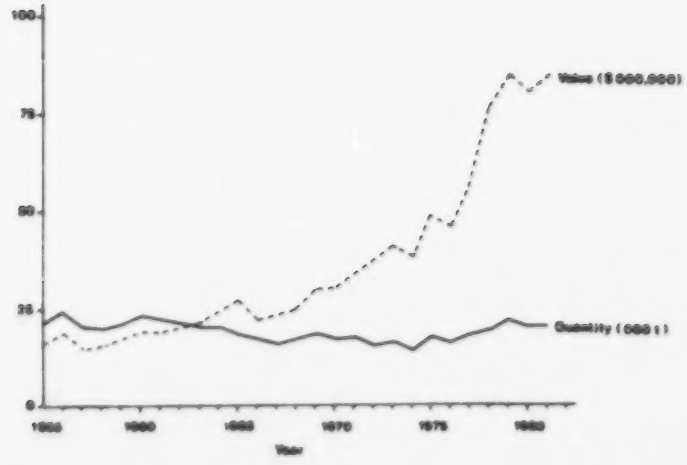

Figure 10. Canadian lobster landings (t) and current value (millions of dollars) between 1955 and 1981.

Although detailed marketing studies are not available there appears to be an increasing demand world-wide for the clawed lobster; Canada is in an unique position of being the only net exporting country. Canadian exporters and European importers (A. Scouarnec,[4] and A.P.M. Verhaart, pers. comm.) have concerns, however. They would like to see a better match of supply with demand. They claim there is a glut of canner-sized lobsters, a seasonal shortfall of small market-sized lobsters, and a year-round shortage of large market-size lobsters. This results first from fishing seasons that often do not match periods of peak consumer demand and second from the exploitation rate of 80% to 90% for most fisheries which has brought the mean size of lobsters in the catch to within a molt or two of legal size.

The present lobster regulations regarding minimum legal carapace size and seasons have not changed in most areas for nearly one-half century. There is some evidence that market demands have changed. The suggested remedial action is to better match fishing seasons and lobster sizes to market demands. This, however, is a large and complex undertaking. Although the lobster industry is the backbone of the inshore fishery, particularly in the Gulf and Scotia-Fundy Regions, fishermen must participate in other fisheries to maintain financial solvency. Thus, any change in lobster seasons will have to be compatible with the timing of these other fisheries. Because all Canadian lobsters go to the same markets, the entire Canadian lobster industry should be considered. Also, such parameters as weather patterns and lobster condition must be considered as well. Furthermore, the movement of minimum legal carapace length upward could reduce both landings and fishermen's incomes for two years or so.

The data presented in this report on marketing were gleened from various sources by D.G. Robinson (second author) and L. Sonkodi. Prior to recommending that a plan be initiated to manipulate seasons and lobster sizes, a thorough marketing study should be carried out by L. Sonkodi in an attempt to both verify the suggested marketing trends and determine their stability.

Once the long-term market demands are determined it would be appropriate to assess the physical and economic ability of the producers to meet these needs and the potential of the stock(s) to yield the required crop.

As outlined earlier, lobster maturation time, fecundity, growth, etc. vary with environmental conditions. Thus, from a stock recruitment aspect it may be more advantageous to grow large market lobsters in hypothetical lobster district A and small market lobsters in hypothetical lobster district B.

---

[4]Mr. R. Scouarnec, lobster importer, Prenal Co., France.

A recommended technique to handle the complexities of this problem would be systems modelling. Input would be required from at least an economist, biologist, marketing specialist, and possibly others.

Fisheries Management generally include industry in resource management decisions. Were it decided to manipulate catch practice all sectors of the industry would have to be consulted. At present there is no formal mechanism to permit industrial input into lobster resource management in the Scotia-Fundy Region. Currently, fisheries personnel organize community meetings on an ad hoc basis only.

A Regional Lobster Committee was set up in Newfoundland in 1977. One fisherman from each lobster fishing district (Fig. 8) as well as representatives from the buying/processing sector are appointed by the Department of Fisheries and Oceans. In addition, the fishermen's union and Provincial Department of Fisheries personnel are invited to name representatives to the Committee. The Director General will not approve lobster regulation or policy change unless it has been vetted in the advisory committee. The Newfoundland scheme appears to have worked well as, among other things, the Committee has recommended that the minimum legal carapace measure be increased to 3.5" (8.9 cm), by 1984.

The various fishing associations in Québec meet monthly. Representatives of Québec fisheries, generally biologists, attend meetings twice yearly to present resource management information.

It is recommended that all regions set up a formal mechanism which would allow industrial input into, and industrial vetting of, lobster resource management plans.

MANAGEMENT ALTERNATIVES

Lobster is a luxury food item that is, for most stocks, easily fished due to its nearshore location. Also, it is pallatable at certain sublegal, immature sizes; consequently, to both conserve the resource and permit optimal returns to the industry it was felt that the fishery will likely always require tight regulations. At present, resource management is attempted by effort control (closed seasons, limited entry and trap limits), minimum legal size limits, and protection of egg-bearing females.

France (G. Conan,[5] pers. comm.) has no regulations other than sanctuaries. The landings have decreased dramatically. Attempts to reseed lobster grounds using culture-raised

---

[5]G. Conan, Research Scientist, Gulf Region, Department of Fisheries and Oceans, Moncton, N.B.

juveniles has failed through lack of ecological knowledge. Sanctuaries may have worked were more information available on source of larval recruitment and on the ecology of the species.

R.D.S. Macdonald[6] (pers. comm.) suggested quotas and enterprise allocation. D. Bevin[7] (pers. comm.) claimed that quotas are much more expensive and much more difficult to enforce. D. Rivard[8] (pers. comm.) noted that it was also more expensive scientifically as annual preseason assessments would have to be made. A quasi-quota approach was suggested; here, the quota would be set on the previous year's landings. This was deemed inappropriate.

Conclusion was that the present system was superior to those proposed; however, it was emphasized that more research was required on the biology of lobster and on economics, marketing, and sociology. It was pointed out that a recent failure to convince certain fishermen's groups in Scotia-Fundy that an increased minimum legal carapace measure was required was due to lack of empirical data in these disciplines. B. Vezina[9] (pers. comm.) suggested that a cost-benefit analysis be made of the industry and also that a cost-earnings study be performed which would include the role of unemployment insurance. Marketing conditions vary continuously; thus, it was recommended (D. Rivard, pers. comm.) that an ongoing marketing study be initiated. In the long term, the process of incorporating marketing and bioeconomic factors in the development of management advice will have to be addressed formally and integrated into the organizational structure.

CONCLUSIONS

1. The lobster fishery was well developed throughout Atlantic Canada by the end of the 19th century.

2. Gasoline engines and parlour traps in the early 20th century and later lorans, radios, depth sounders, trap haulers, larger boats, etc. increased the efficiency of lobster fishermen.

3. Landings in all lobster fishing districts dropped markedly between 1900 and 1935.

---

[6]R.D.S. Macdonald, Economist, Scotia-Fundy Region, Department of Fisheries and Oceans, Halifax, N.S.
[7]D. Bevin, A/Area Manager, Scotia-Fundy Region, Department of Fisheries and Oceans, Yarmouth, N.S.
[8]D. Rivard, Scientific Advisor, Department Fisheries and Oceans, Ottawa, Ont.
[9]B. Vezina, Department of Fisheries and Oceans, Ottawa, Ont.

4. The lobster fishery has collapsed in Northumberland Strait and off eastern Nova Scotia.

5. Atlantic Canada's poorest quality lobsters come from District 8 as fishing coincides with the annual molt.

6. Little is known about the distribution of fishing effort on all coasts or the effective effort expended.

7. Annual landings in Newfoundland and most fishing districts are liable to fluctuate markedly due to the heavy reliance on annual recruitment.

8. The lobster fishery is characterized by economic inefficiency as present catch levels could be maintained with less effort and smaller capital investments.

9. The Canadian lobster industry is both sufficiently large and geographically varied that all demands of the marketplace could be met.

10. Canada is the only country that is a net exporter of the clawed lobster.

11. The intensity of the modern lobster fishery manifests itself in a catch where the majority of lobsters are newly recruited to legal size; hence, there is a shortage of market-sized lobsters.

12. The lobster fishery is the backbone of the Canadian Atlantic inshore mixed fishery; consequently, changes in seasons must be compatible with the execution of the other fisheries.

13. Biological yield per recruit, and possibly reproductive success, would be increased if the minimum legal carapace lengths were increased.

14. A formal mechanism for industrial input into lobster management does not exist in the Gulf and Scotia-Fundy Regions.

15. At present, too little is known about the population biology and ecology of lobsters, particularly pertaining to population boundaries, source and level of recruitment, population structure, and movement to permit the design and implementation of a management system which would maximize the yields from the lobster fishery in a manner similar to that possible for groundfish fisheries.

SUMMARY AND RECOMMENDATIONS

Since the latter part of the 19th century lobster fishing has been ubiguitous in eastern Canadian waters between 42°N and 53°N.

The fishery began in most areas as a canner fishery (in 1851 there were five small canneries in western Nova Scotia). By 1873 there were 67 canneries in Nova Scotia; by 1890 there were 331 in the Maritimes, despite a live market trade which began in 1881. Regulations on size and possession of egg-bearing females existed but were difficult to enforce.

Landings peaked at 105 million lb (47600 t) in 1886 and troughed at 26.9 million lb (12000 t) in 1924. Since, there have been secondary peaks at about 48.5 million lb (22000 t) in the late 1930's and 1950's. Catches were so poor in Newfoundland in the 1920's that a total closure was introduced between 1925 and 1927.

The demand for live lobsters increased in the late 1920's, but it was not until 1933 that a market size limit of 3.2" (8.1 cm) was promulgated in southwestern Nova Scotia. By 1940 a small section of Richmond County had attained market size, but there is yet a portion of eastern Cape Breton that has a canner size limit.

Lobsters attain reproductive maturity at a smaller size in warmer, southern Gulf of St. Lawrence waters. The canner size of 2.5" (6.35 cm) prevails in this fishery. The Magdalen Islands fishery, however, was increased from canner size to 3.0" (7.6 cm) between 1953 and 1957; landings peaked approximately one lobster generation later but have since declined.

Little is known about the population biology of lobsters. We have little knowledge of the following: population (a group of animals of the same species living sufficiently close to one another to permit interbreeding) size, level of recruitment, source of recruitment (little knowledge on larvae and juveniles), adult population structure, age composition, growth and mortality, and movement. Consequently, it is difficult to convince fishermen to take certain conservation measures. Stock assessment analysis suggests that all fisheries are recruitment overfished and that yield per recruit could be improved. Recommendations have been made, to increase minimum legal carapace size to 3.0" (7.6 cm) in warm, southern Gulf of St. Lawrence waters and 3.5" (8.9 cm) or 4.0" (10.2 cm) in the colder water stocks.

Market trends are changing. Until recently lobster marketing was basically live sales to American brokers and canned sales to U.S. and other markets. Aggressive marketing,

based on the following, has improved markets: 1) the live clawed lobster is a unique and desirable product throughout the world; 2) the clawed lobster, in-shell, commands luxury food prices; 3) live lobsters may be transported anywhere in the world by air; and 4) Canada is the only major net exporter of lobster. Exporters now claim that seasonal supply and lobster size do not match demand; there is a glut of the wrong sized lobsters at certain times and an insufficient supply of the right sized lobsters at other times. A study is recommended to assess long-term trends in markets and cost-benefit analyses of the fishery.

Exporters and importers often complain about quality of the catch. Excessive mortality of Newfoundland lobsters often occurs due to previous storage, by local buyers and fishermen, in low-saline waters. Lobsters from all regions often have claws missing (due to rough handling by fishermen) or develop diseases and infection in wounds caused by lobster claw pegging or lobster fighting while in storage or transport (lack of claw immobilization). The following recommendations are made:

A) Marketing and Economic Research

1) In view of the lack of data on marketing of lobsters the following study should be carried out in the context of the next five years:

> Estimate month-by-month Canadian lobster consumption by product and export potential to the U.S.A. and Europe by product (taking into account seasonality of domestic landings). Some speculation on price changes should be given, were monthly supply changed to better match monthly demand.

2) If the study above demonstrates that there are, over the long term, open markets that could be captured by Canadian lobsters then an ad hoc, inter-regional committee should be struck to oversee a study, the objective of which would be to recommend harvesting strategy (district fishing seasons and carapace lengths). This study must include a cost-benefit analysis of proposed changes in fishing strategy.

3) Undertake a cost-earnings study of the lobster industry; this should include government subsidies, with particular emphasis placed on the role of unemployment insurance in influencing the industry.

4) That an ongoing marketing analysis for lobsters be undertaken since marketing conditions are constantly changing.

B) Regional Lobster Management

1) That all Regions set up a formal mechanism which would allow industry's input into, and industry's review of, lobster resource management plans.

2) That the regional lobster management committees, as a first step, consider the introduction of the following regulation changes which would increase both yield per recruit and egg production per recruit:

i) a 3.0" (7.6 cm) minimum legal carapace length for warm-water stocks (southern Gulf of St. Lawrence);

ii) a 3.5" (8.9 cm) minimum legal carapace length for cold-water stocks; and

iii) the mandatory installation of escape vents in lobster traps.

3) That a system be put in place to accurately assess and record monthly lobster landings for the smallest possible management units, i.e. all fishing ports if feasible.

4) That the regional lobster management committees consider the introduction of the following procedures to their respective lobster fisheries:

i) the non-damaging immobilization of claws of all lobsters in all areas;

ii) on-board holding tanks; and

iii) on-board preweighed crates or trays.

C) Quality Control Research

That the Department of Fisheries and Oceans carry out research on the following items which, if successful and the techniques implemented, would improve lobster quality:

i) non-damaging claw immobilization techniques;

ii) the design of lobster holding units;

iii) improvements in the diagnostic techniques for assessing the incidence of Gaffkaemia (redtail disease); and

iv) an improved monitoring, certification, and in-plant sampling program for lobsters.

D) Biological Research

Although there is considerable knowledge available on some aspects of the biology of lobster there is a lack of information on population biology. Thus, ecological studies must be mounted which would emphasize and determine the following:

i) the discrimination of populations;

ii) the sources of recruitment;

iii) the levels of recruitment;

iv) in situ growth rates;

v) mortality estimates;

vi) age and size structure of populations and their movement;

vii) that techniques be developed and put in place to efficiently and accurately assess lobster fishing effort; and

viii) That one of the current methods of controlling individual fishing effort, limits on number of traps in use, be evaluated for its role in conservation and if found wanting, the suggestion of alternative techniques.

ACKNOWLEDGEMENTS

The authors thank all that attended the workshop (p. 89); the report benefitted from the discussions that took place there. Data were kindly donated by Mr. L. Sonkodi (lobster marketing) and Mr. Monette (Québec landings). Dr. J.E. Stewart, Director of the Fisheries Research Branch, Scotia-Fundy Region, has a special interest in lobsters and the lobster fishery. It was this interest that spurred on this overview of the fishery; his guidance and concern were appreciated. Drs. D. Rivard, R.J. Miller, and J.E. Stewart; Messrs. L. Sonkodi, J. Nelson, and B. Venzina are thanked for their extensive reviews of the manuscript; and Ms. S. LeBlanc, Ms. V. Clayton, and Ms. L. Boston assisted in the preparation of the report.

REFERENCES

Anonymous. 1980. Annual report 1979-80. Department of Fisheries and Oceans Canada, 26 pp.

---------- 1975. Lobster fishery task force, final report, 180 pp.

---------- 1890. Annual report of the Department Marine Fish. Appendix 8: 127-136.

Anthony, V.C. and J.F. Caddy. 1980. Proceedings of the Canada-U.S. Workshop on status of assessment science for N.W. Atlantic lobster (Homarus americanus) stocks (St. Andrews, N.B., Oct. 24-26, 1978). Can. Tech. Rep. Fish. Aquat. Sci. 932, 186 pp.

Belzile, L. (MS) 1981. La pêche commerciale du homard en Gaspéie de 1975 à 1981. Office de planification et de développement du Québec - Rimouski.

Bergeron, J. 1967. La pêche commerciale du homard (Homarus americanus Milne-Edwards) au Québec des origines à nos jours. Sta. Biol. mar. Grande-Rivière, Cah. Inf. 42, 47 pp.

Billette, R. (MS) 1972. Etude sur le homard. Min. Industrie et Commerce, Direction des pêches maritimes, Service de l'économie, 27 pp.

Bureau de la statistique du Québec. 1950-1971. Statistiques des pêches maritimes.

Campbell, A. 1980. A review of mortality estimates of lobster populations in the Canadian Maritimes. In Proceedings Can.-U.S. Workshop on Status of Assessment Science for N.W. Atlantic Lobster (Homarus americanus) Stocks (St. Andrews, N.B., Oct. 24-26, 1978) (ed. Anthony, V. and J.F. Caddy). Can. Tech. Rep. Fish. Aquat. Sci. 932: 29-36.

Campbell, A. and R.K. Mohn (in press). Lobster stock definition for the Canadian Maritimes by analysis of landing trends. NAFO Spec. Pub.

Campbell, A. and D.R. Duggan. 1980. Review of the Grand Manan lobster fishery with an analysis of recent catch and effort trends. Can. Tech. Rep. Fish. Aquat. Sci. 997, 20 pp.

Dupont, J.-N. et F.-R. Boudreault. 1976. Prédiction des débarquements de homard aux Iles de la Madeleine: II - Régression multiple sur les composantes principales. Dir. Rech., Dir. Pêches marit., Min. Industrie et Commerce, Cah. Inf. 73: 67-101.

Ennis, G.P. 1981. Variation in annual growth in a Newfoundland population of lobsters (Homarus americanus) in relation to temperature conditions. CAFSAC Res. Doc. 81/64, 6 pp.

Ennis, G.P. 1978. Yield per recruit assessments for Newfoundland lobster stocks. CAFSAC Res. Doc. 78/31, 18 pp.

Found, W.A. 1927. Memorandum for Royal Commission to investigate fishery conditions and requirements of the Maritime provinces including the Magdalen Islands. Queens Printers, 1927, 51 pp.

Halkett, A. 1916. In Annual Report of the Department of Marine Fish. Natural History Report. Appendix 16: 349-355.

Harding, G.C. K.F. Drinkwater, and W.P. Vass. 1983. Factors influencing the sizes of lobster stocks along the Atlantic coast of Nova Scotia, Gulf of St. Lawrence, and Gulf of Maine: A new synthesis. Can. J. Fish. Aquat. Sci. 40: 168-184.

Lavoie, N. 1977. Report of the cruise of the government steamer Lady Head in the protection of the fisheries of the Gulf and River St.-Lawrence during the season of 1876, under command of Napoleon Lavoie, Esq. fishery officer. Report of the Commissioner of Fisheries for the year ending 31 December 1876 (1877). Appendix 3: 44-147.

Li, M.F., J.W. Cornick, and R.J. Miller. 1982. Studies of recent mortalities of the sea urchin (Strongylocentrotus droebachiensis) in Nova Scotia. ICES C.M. 1982/L:46, 6 pp.

Mann, K.H. and P.A. Breen. 1972. The relation between lobster abundance, sea urchins, and kelp beds. J. Fish. Res. Board Can. 29: 603-605.

Mann, K.H. 1977. Destruction of kelp beds by sea urchins: A cyclical phenomenon or irreversible degradation. Helgol. wiss Meeres. 30: 455-467.

Munroe, J. and J.C. Therriault. 1981. Abundance distribution, probilité et fréquencie de miue de la population de homards des lagunes des Iles-de-la-Madelaine. Rapport Technique Canadian des Sciences Halieutiques et Aquatiques 1034, 35 pp.

Pielou, E.C. 1976. Population and community ecology, principles and methods. Gordon and Breach Science Publishers, New York, 424 pp.

Prince, E.E. 1899. Report of the Canadian Lobster Commission, 1898. In 31st Ann. Rep. Dept. Mar. Fish., 1899, Supplement 1, 41 pp.

Pringle, J.D., G.J. Sharp, and J.F. Caddy. 1982. Interactions in kelp bed ecosystems in the northwest Atlantic: Review of a workshop. In Multispecies Approaches to Fisheries Management Advice (ed. Mercer, M.C.). Can. Spec. Pub. Fish. Aquat. Sci. 59: 108-115.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191, 382 pp.

Robinson, D.G. 1979. Consideration of the lobster (Homarus americanus) recruitment overfishing hypothesis, with special reference to the Canso Causeway. In Proceedings of the Canso Marine Environment Workshop (ed. McCracken, F.D.). Fish. Mar. Serv. Tech. Rep. 834, Part 3: 77-99.

Robinson, D.G. 1980. History of the lobster fishery on the eastern shore of Nova Scotia. In Proceedings of the Workshop On the Relationship Between Sea Urchin Grazing and Commercial Plant/Animal Harvesting (ed. Pringle, J.D., G.J. Sharp, and J.F. Caddy). Can. Tech. Rep. Fish. Aquat. Sci. 954: 8-23.

Robinson, D.G., J.D. Pringle, A. Campbell, and R.W. Elner. In press. Discussion paper on Lobster management. Can. MS Rep. Fish. Aquat. Sci.

Robinson, D.G. and J.D. Pringle. In press. Application of a simplified stock recruitment mode to some Maritime lobster populations. CAFSAC Res. Doc.

Rutherford, J.B., D.G. Wilder, and H.C. Frick. 1967. An economic appraisal of the Canadian lobster fishery. Bull. Fish. Res. Board Can. 157, 126 pp.

Sutherland, D.H. 1937. Annual reports of chief supervisors of fisheries, Appendix I. In Ann. Rep. Dept. Fish. 30.

Templeman, W. 1936. The influence of temperature, salinity, light, and food conditions on the survival and growth of the larvae of the lobster (Homarus americanus). J. Biol. Board Can. 2(5): 485-497.

Wakeham, W. 1909. Evidence taken (re lobster fishery) pursuant to Order in Council dated June 21, 1909: 1,227.

Wharton, W.G. and K.H. Mann. 1981. Relationship between destructive grazing by the sea urchin, Strongylocentrotus droebachiensis, and the abundance of American lobster, Homarus americanus, on the Atlantic coast of Nova Scotia. Can. J. Fish. Aquat. Sci. 38: 1,339-1,349.

Wilder, D.G. 1954. La pêche du homard dans le sud du golfe Saint-Laurent. Office des recherches sur les pêcheries du Canada. Sta. Biol. Atl. Cir. 24: 1-16.

Wilder, D.G. 1963. Movement, growth and survival of marked and tagged lobsters liberated in Egmont Bay, Prince Edward Island. J. Fish. Res. Board Can. 20: 305-318.

Appendix A

List of Workshop Attendees

Name	DFO Affiliation
D. Rivard	Fisheries Research Directorate, Ottawa, Ont.
B. Vezina	Atlantic Operations Directorate, Ottawa, Ont.
L. Sonkodi	Marketing Directorate, Ottawa, Ont.
G. Conan	Fisheries Research Branch, Gulf Region, Moncton, N.B.
D.R. Maynard	Fisheries Research Branch, Gulf Region Moncton, N.B.
F. Bryan	Fisheries Operations Branch, Gulf Region, Moncton, N.B.
G.P. Ennis	Fisheries Research Branch, Newfoundland Region, St. John's, Nfld.
G. Crawford-Dawe	Economics Branch, Newfoundland Region, St. John's, Nfld.
L. Rowe	Operations Branch, Newfoundland Region, St. John's, Nfld.
J. Marshall	Area Director, Gulf Region, Corner Brook, Nfld.
P.M. Hart	Economics Branch, Scotia-Fundy Region, Halifax, N.S.
R.D.S. Macdonald	Economics Branch, Scotia-Fundy Region, Halifax, N.S.
D. Bevan	Fisheries Operations Branch, Scotia-Fundy Region, Halifax, N.S.
G. Stevens	Fisheries Operations Branch, Scotia-Fundy Region, Halifax, N.S.
D.G. Robinson	Fisheries Operations Branch, Scotia-Fundy Region, Halifax, N.S.
M. Sinclair	Fisheries Research Branch, Scotia-Fundy Region, Halifax, N.S.
J.D. Pringle	Fisheries Research Branch, Scotia-Fundy Region, Halifax, N.S.

Province of Québec

P. Dubé	Department of Agriculture and Fisheries, Magdalen Islands, P.Q.
M. Monette	Department of Agriculture and Fisheries, Gaspé, P.Q.

Appendix B

Letter of Invitation to Workshop
- Mandate -

Government of Canada / Gouvernement du Canada

MEMORANDUM **NOTE DE SERVICE**

TO / A: Distribution

FROM / DE:
R.A. Crouter
Director General
Fisheries Management
Atlantic Fisheries Service
Scotia-Fundy Region

SECURITY CLASSIFICATION / DE SÉCURITÉ

OUR FILE / NOTRE RÉFÉRENCE: 2348-6

YOUR FILE / VOTRE RÉFÉRENCE:

DATE: May 14, 1982

WORKSHOP ON THE MANAGEMENT OF THE LOBSTER FISHERY IN THE ATLANTIC ZONE

Personnel of the Fisheries Research Branch, Scotia-Fundy Region, developed a summary document on the management of the lobster fishery in the Maritimes. A.W. May felt a similar document covering the Atlantic Zone was required. A workshop was suggested as the best method for developing "An Overview of the Management of the Lobster Fishery in the Atlantic Zone." J.D. Pringle has organized the workshop for June 22 and 23. It will be held in the Conference Room, Halifax Laboratory, 1707 Lower Water St., beginning at 0900 h.

The topics that will be discussed and likely to make up chapters within the document are as follows:

a) Brief history of the fisheries;
b) Review of stock status;
c) Brief review of biological assessment techniques;
d) Current management regimes;
e) Markets and developing trends; and
f) Management alternatives.

Each region is responsible for submitting a document which will include material from their region on each of the above headings. This material will be submitted to each region for review by June 15. The meeting will be attended by one delegate from each regional branch of Economics, Fisheries Research, and Fisheries Operations.

Your cooperation is solicited.

Original Signed By

R.A. Crouter

Distribution

L.J. Cowley
E.B. Dunn

Appendix C

Agenda of Workshop

AGENDA

1. Mandate of the workshop.

2. Is there a need for an Atlantic zone lobster management plan?

3. Marketing and economics:

   - optimizing returns
   - market trends
   - seasonal supply
   - lobster size and demand
   - lobster quality
   - conclusions.

4. Current status of lobster stocks:

   - Districts 11-14 (Newfoundland)
   - Districts 9a-10d (Quebec)
   - Districts 1-8 (Maritimes)
   - fishing pressure
   - environmental quality
   - conclusions.

5. Structure for development of resource management advice in each Region:

   - data acquisition and data synthesis
   - industrial input
   - conclusions.

6. Management alternatives.

7. Atlantic zone coordination in lobster management:

   - structure required
   - conclusions.

8. Recommendations toward a Resource Management Plan for Lobsters.

Appendix D

Seasons and Carapace Lengths for Lobster Fishing Districts in Atlantic Canada

District number	Minimum legal size (carapace length, cm)	Season
1	8.1 (3-3/16")	Second Wednesday in November to third Thursday in June
2	8.1 (3-3/16")	Second Wednesday in November to third Thursday in June
3	8.1 (3-3/16")	October 15 to December 31; March 1 to July 31
4	8.1 (3-3/16")	Last Thursday in November to May 31
5	8.1 (3-3/16")	April 20 to June 20
6a	8.1 (3-3/16")	May 20 to July 20
6b	6.35 (2-1/2")	May 16 to July 15
7a	8.1 (3-3/16")	May 1 to June 30
7b	6.35 (2-1/2")	May 1 to June 30
7b1	6.35 (2-1/2")	May 1 to June 30
7c	6.35 (2-1/2")	May 1 to June 30
8	6.35 (2-1/2")	August 10 to October 10
9a	7.6 (3")	May 10 to June 10
9b	-	No open seasons in lagoons
10a	7.6 (3")	May 10 to July 31
10b	7.6 (3")	June 15 to August 15
10c	7.6 (3")	May 10 to July 31
10d	7.6 (3")	May 1 to July 17
11	8.1 (3-3/16")	April 20 to July 5
12	8.1 (3-3/16")	May 5 to July 10
13	8.1 (3-3/16")	April 20 to July 15
14	8.1 (3-3/16")	April 20 to June 30
Offshore A	8.1 (3-3/16")	Nine months per vessel